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Zhang et al.

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(54) **BACKLIGHT MODULE AND DISPLAY DEVICE**

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G02F 1/1345 (2006.01)
G02F 1/136 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/002*** (2013.01); ***G02B 6/0043*** (2013.01); ***G02B 6/0061*** (2013.01); ***G02B 6/0088*** (2013.01); ***G02F 1/136*** (2013.01); ***G02F 1/13452*** (2013.01); ***G02F 1/13458*** (2013.01)

(58) **Field of Classification Search**
CPC G02B 6/002; G02B 6/0043; G02B 6/0061
See application file for complete search history.

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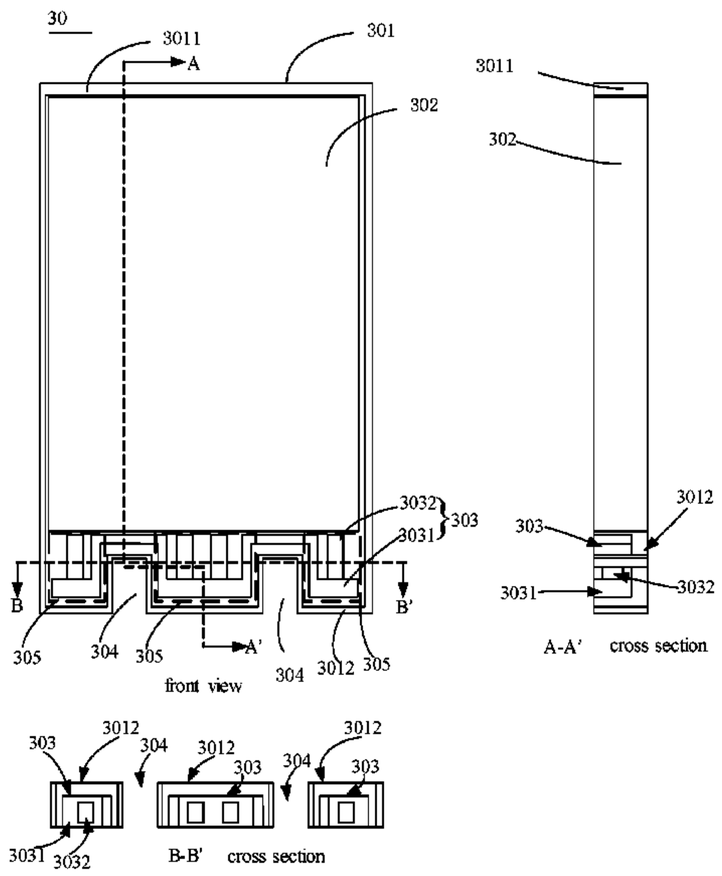
Primary Examiner — Donald L Raleigh

(57) **ABSTRACT**

A backlight module and a display device, by disposing backlight concave sections on a light source lateral side of a back frame in the backlight module, the backlight concave sections and panel concave sections on a display panel correspond to one another. During assembling, part of sections of a flexible electric circuit board is bent to back of the backlight module through an edge of the panel concave section and the backlight concave sections to reduce a size of a bottom bezel of the display device, which improves the screen-to-body ratio of the display device.

20 Claims, 19 Drawing Sheets



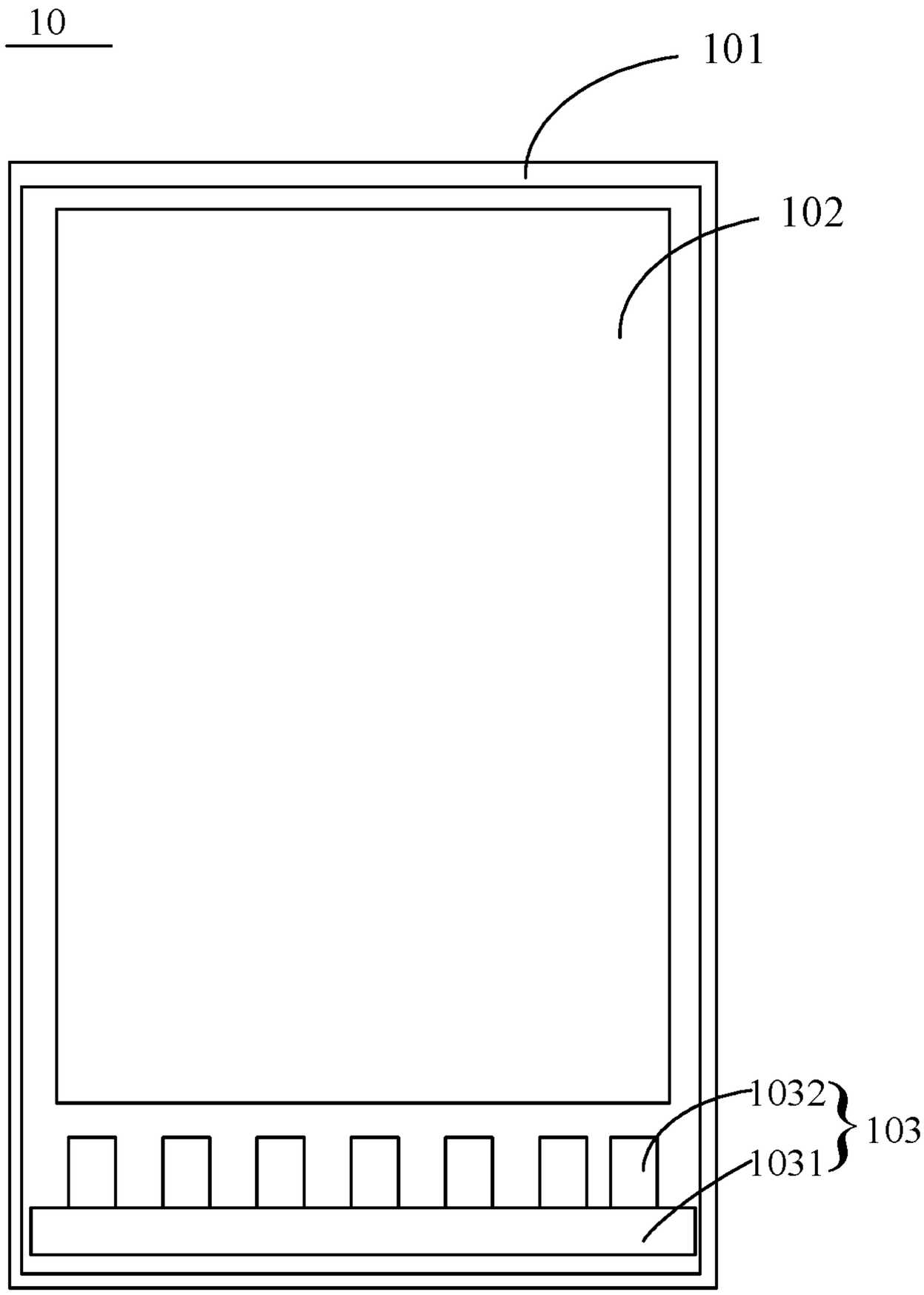


FIG. 1

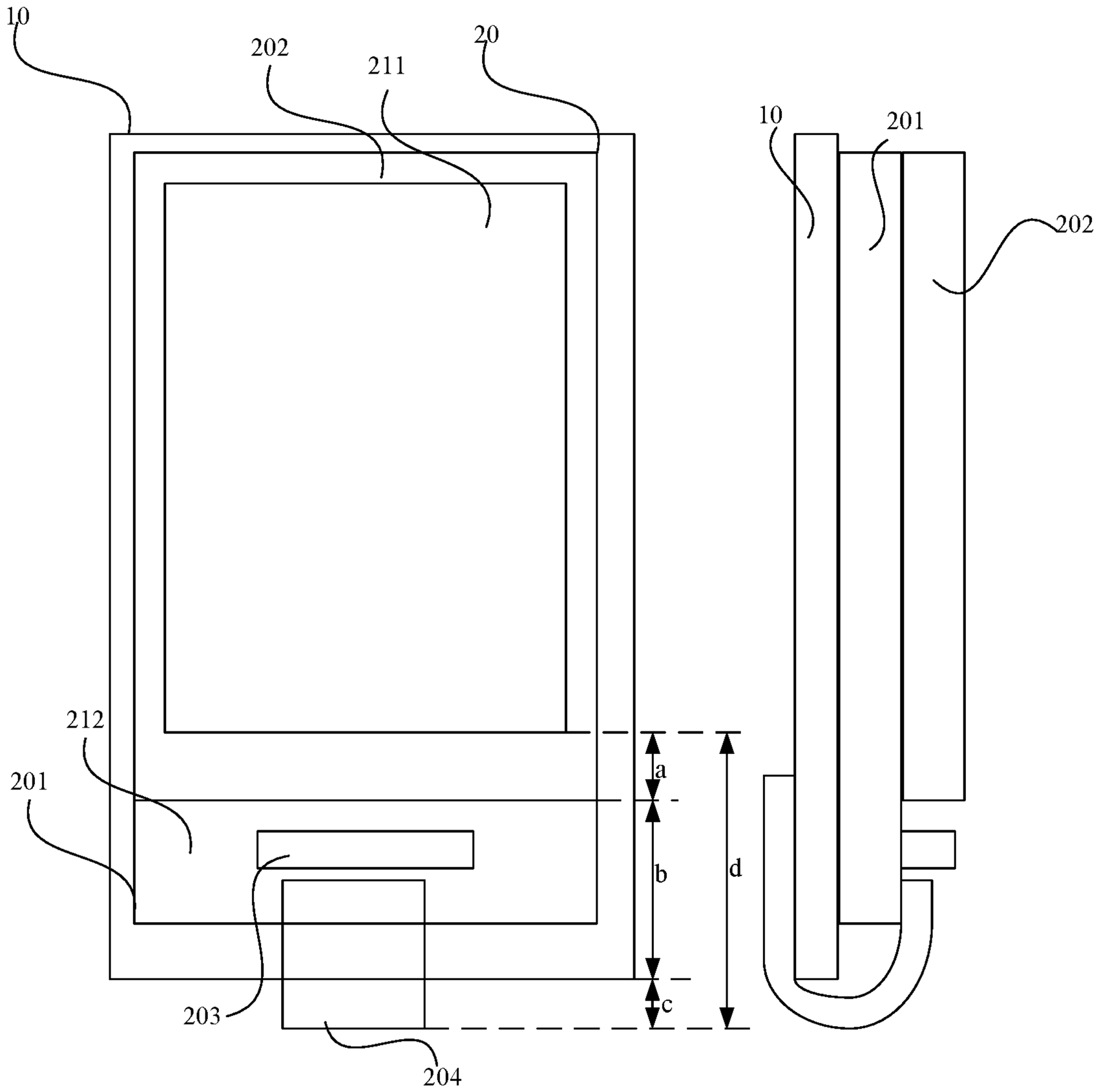
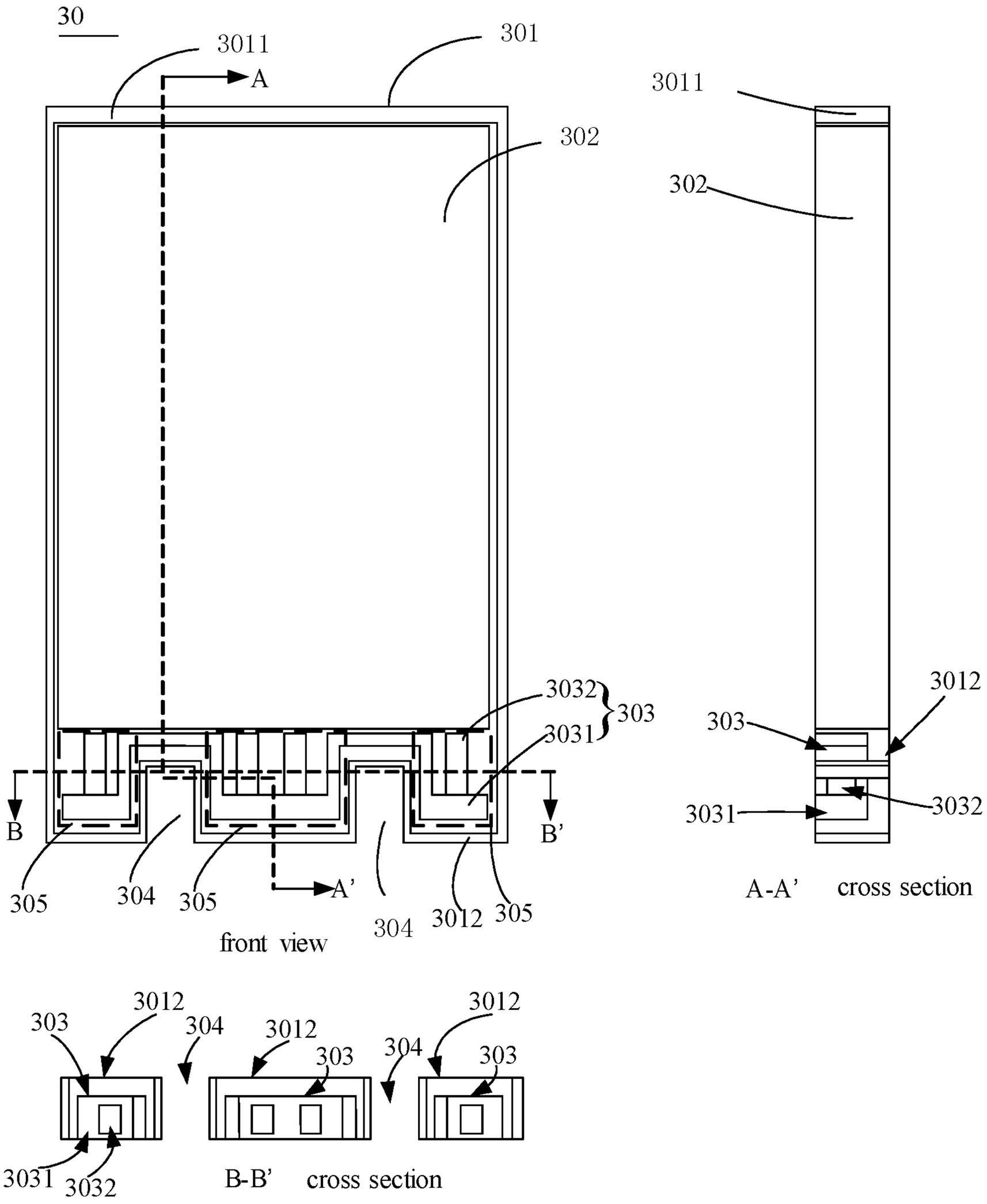


FIG. 2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B
B'
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304
305
A'
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3012
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front view
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3012
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3031
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A-A' cross section
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3012
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3032
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FIG. 3

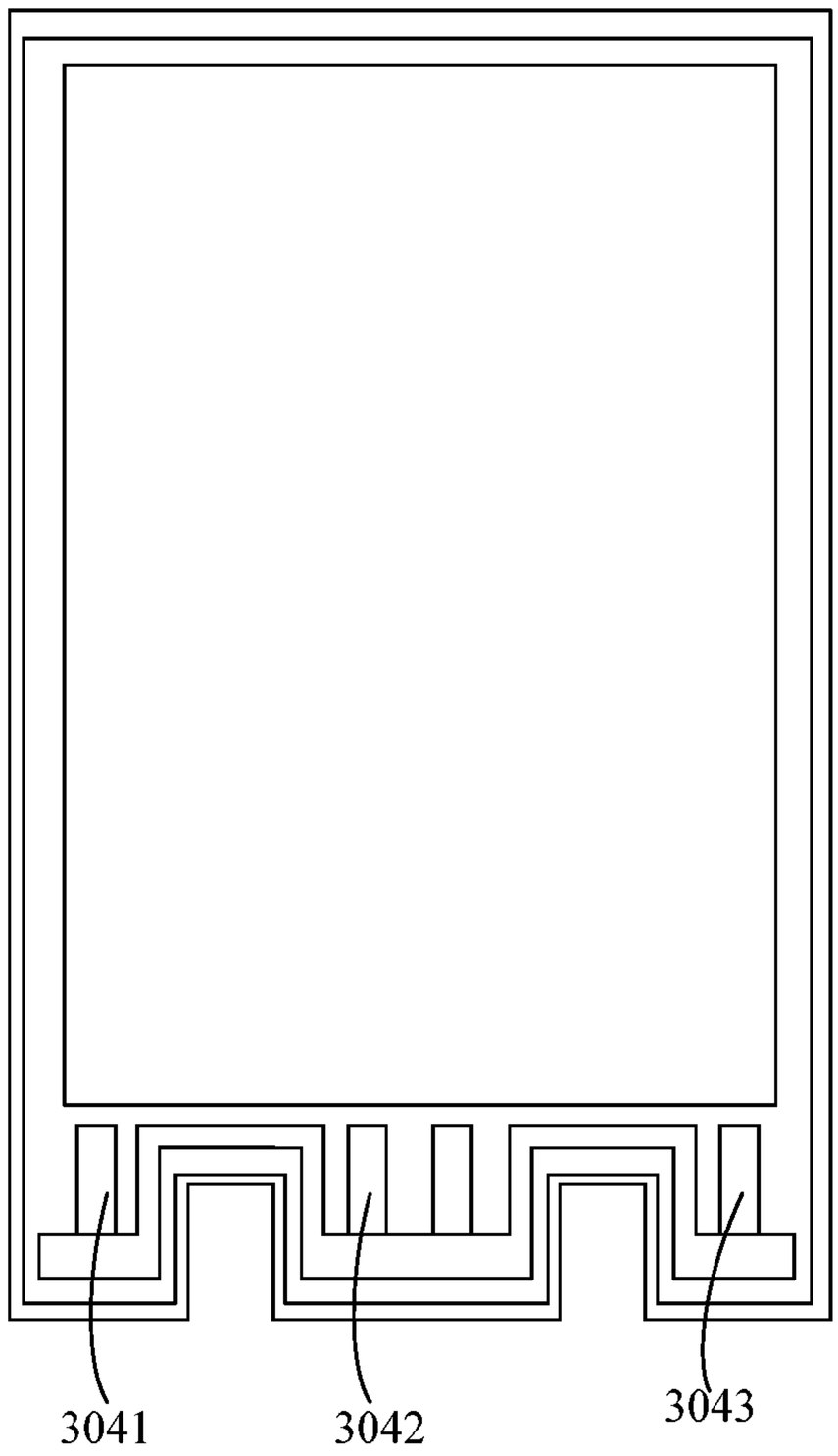

FIG. 4

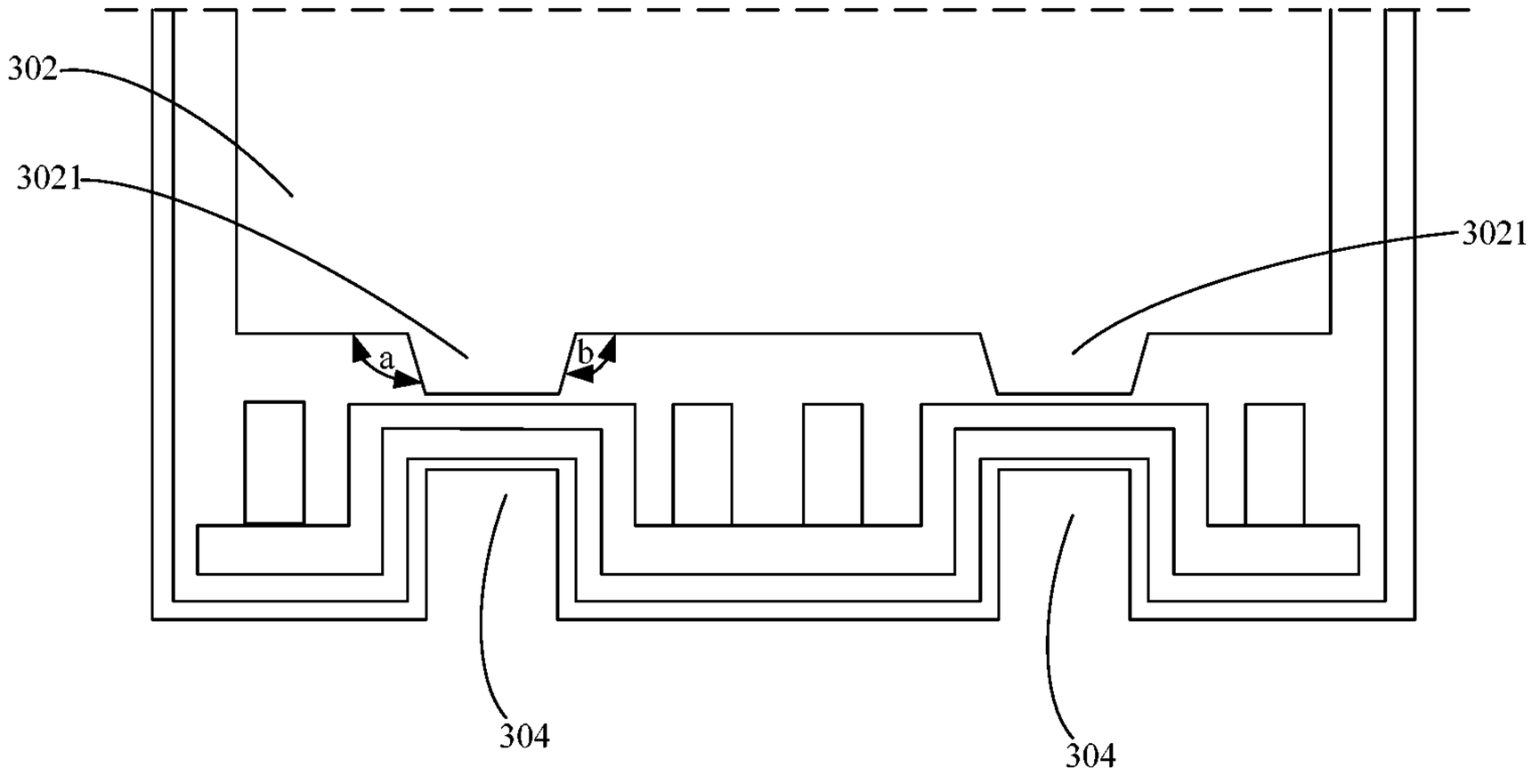

FIG. 5

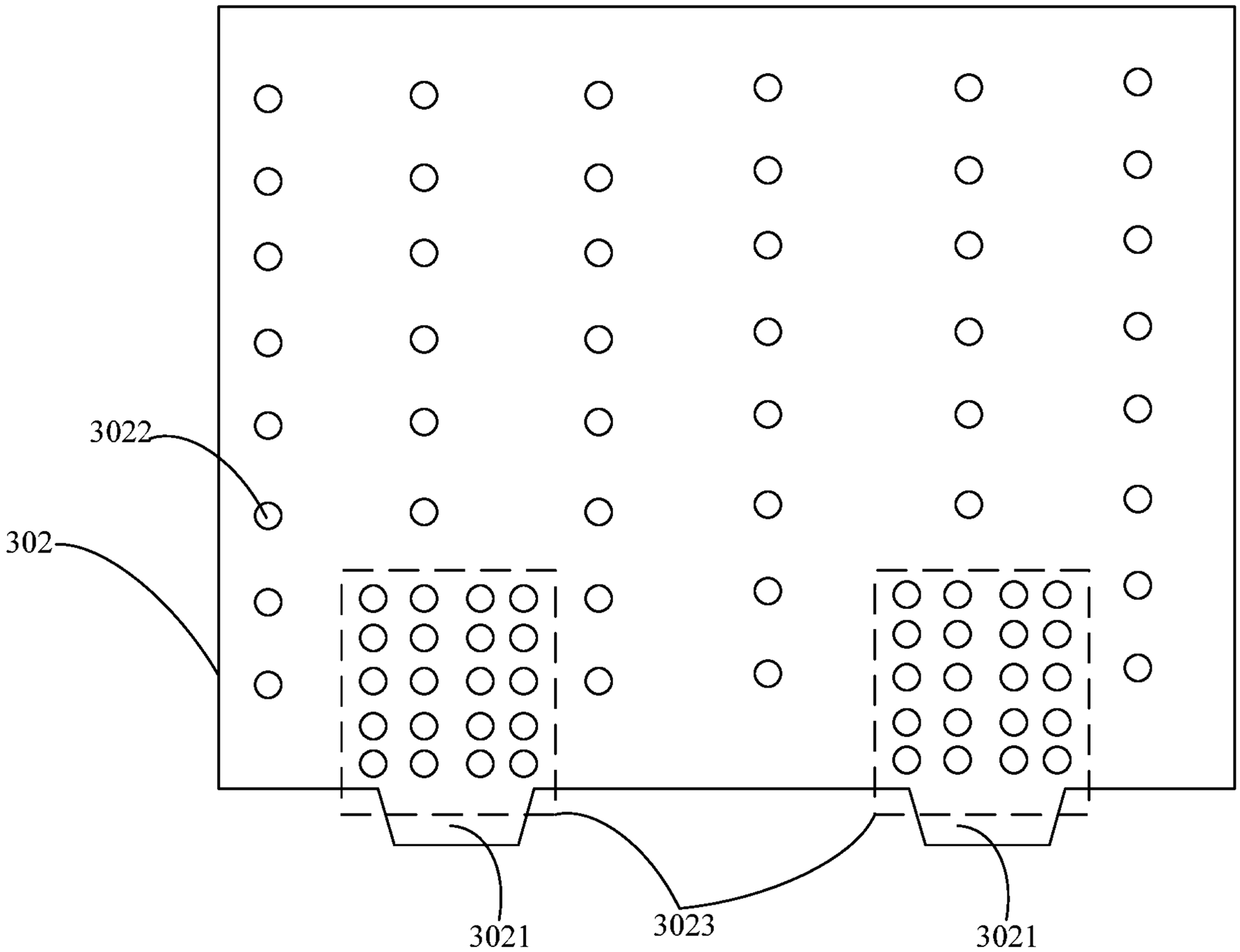

FIG. 6

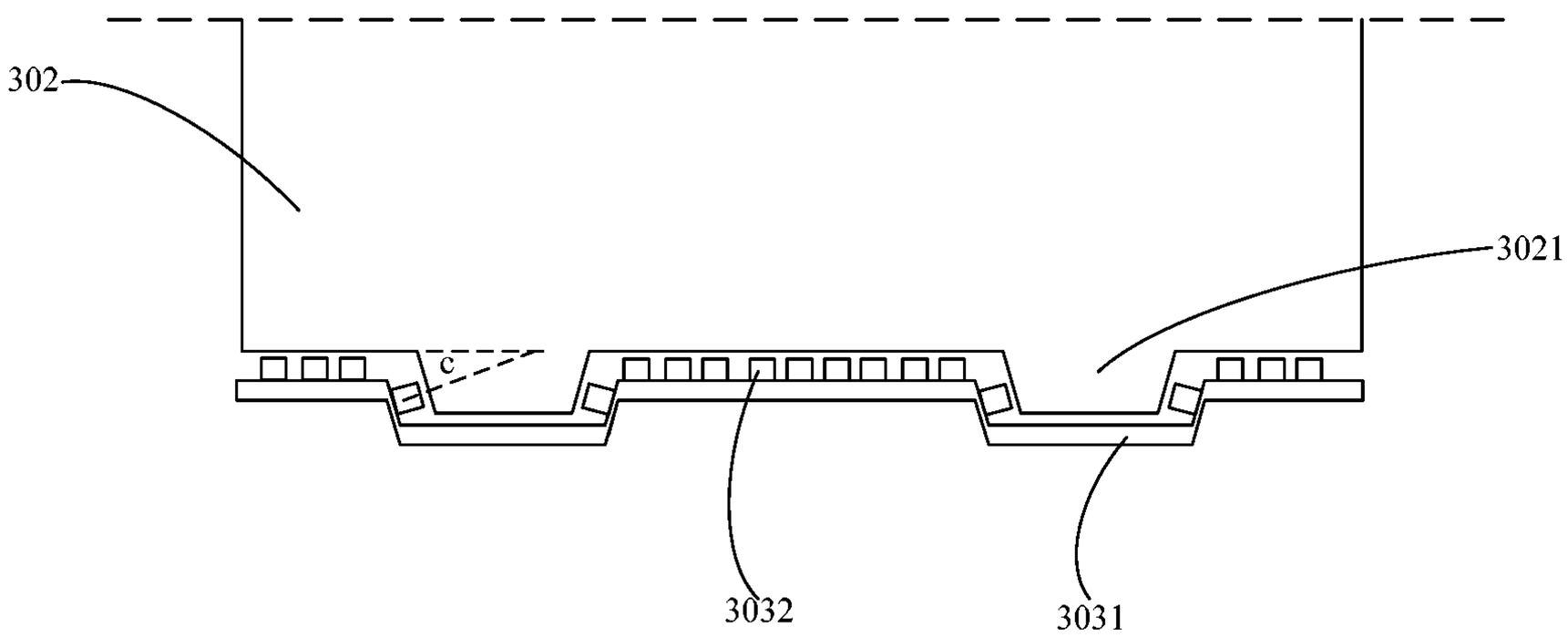

FIG. 7

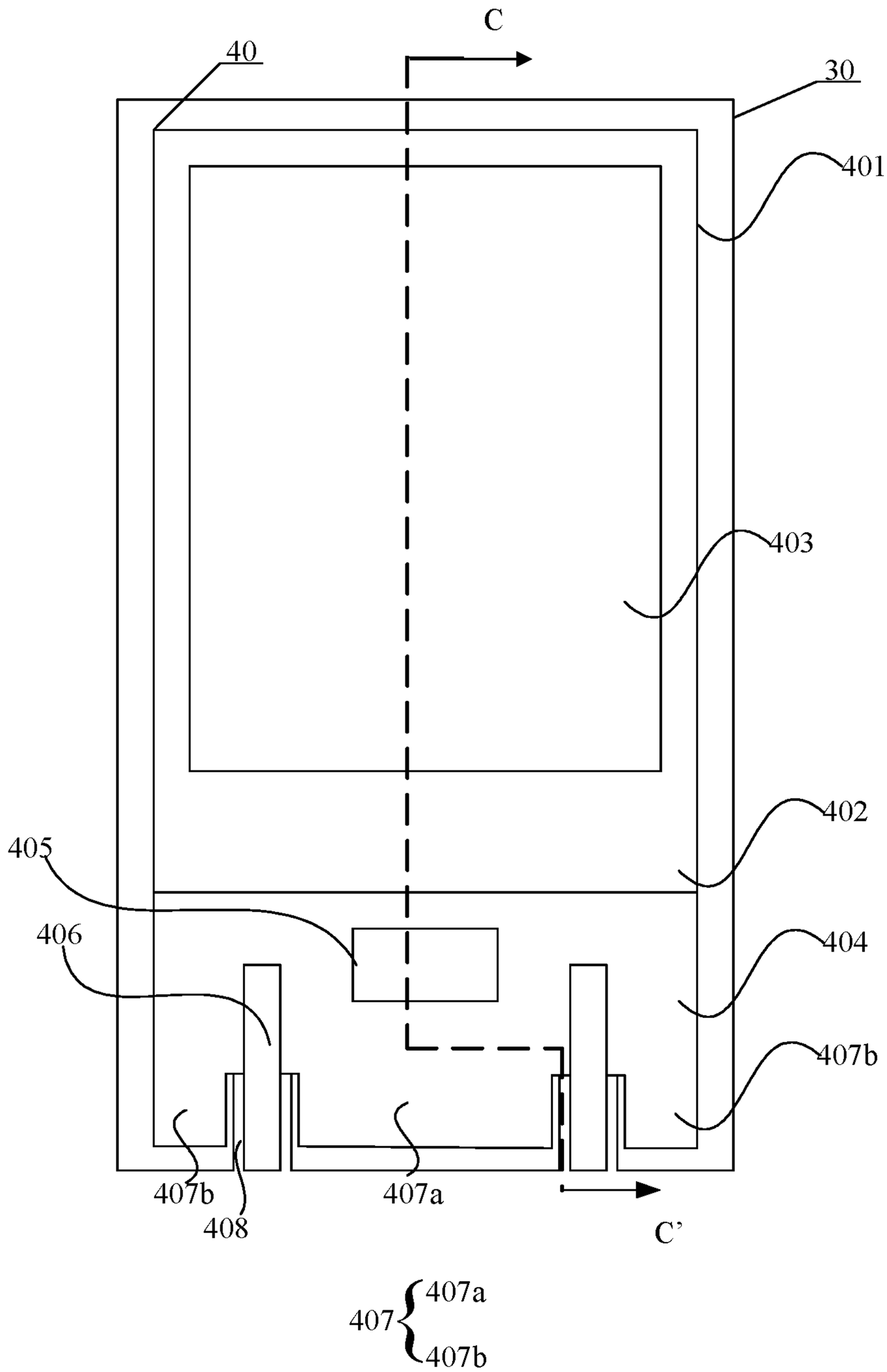
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FIG. 8

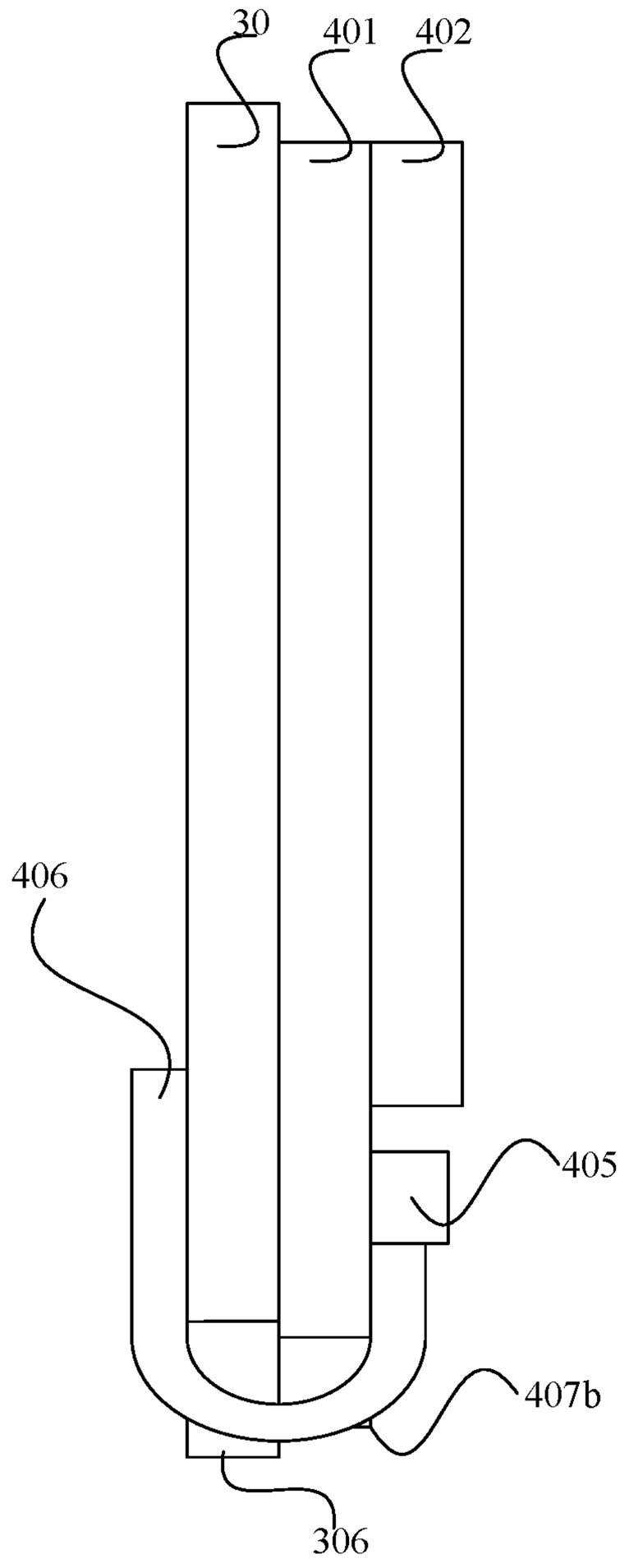

FIG. 9

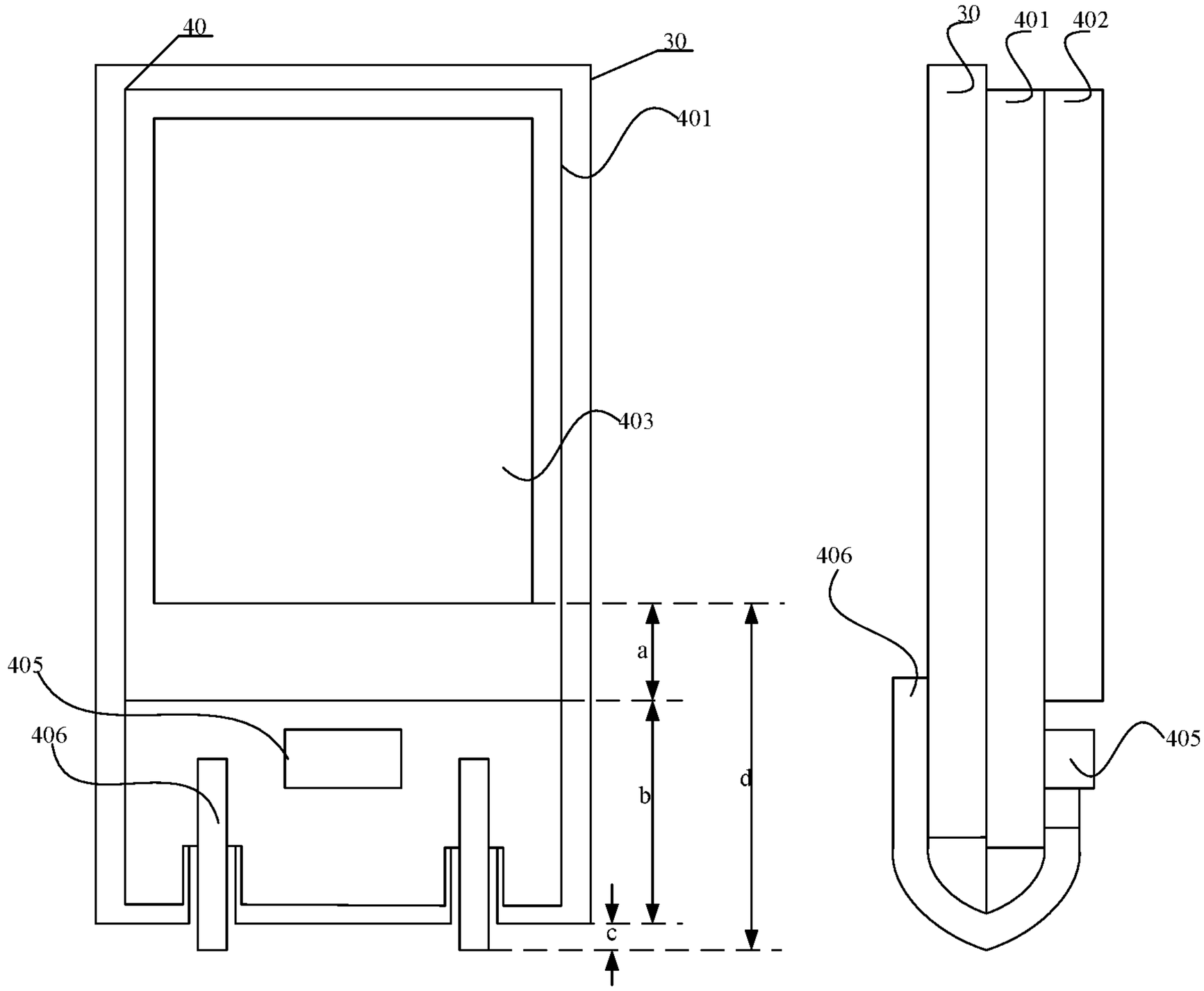

FIG. 10

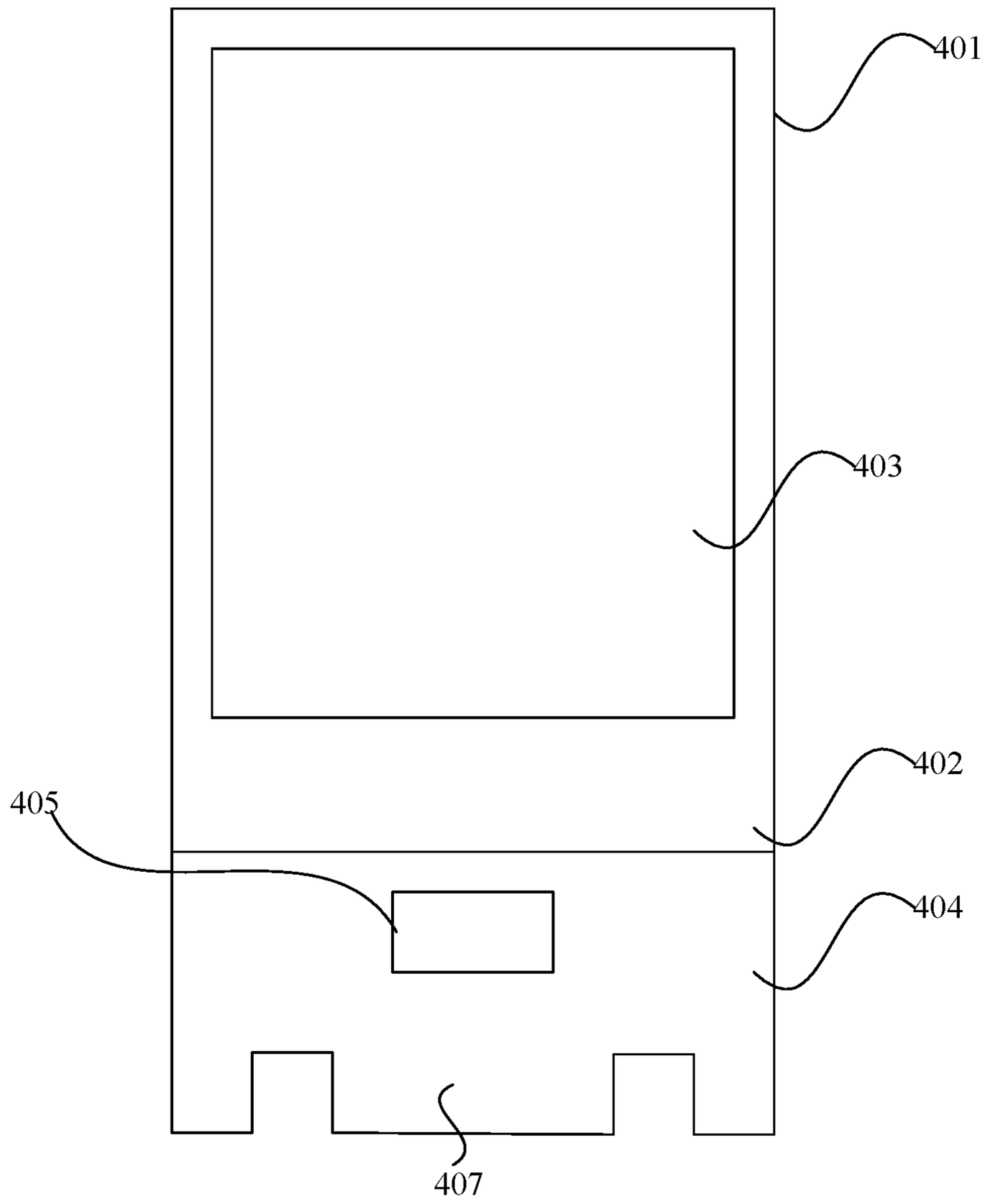

FIG. 11

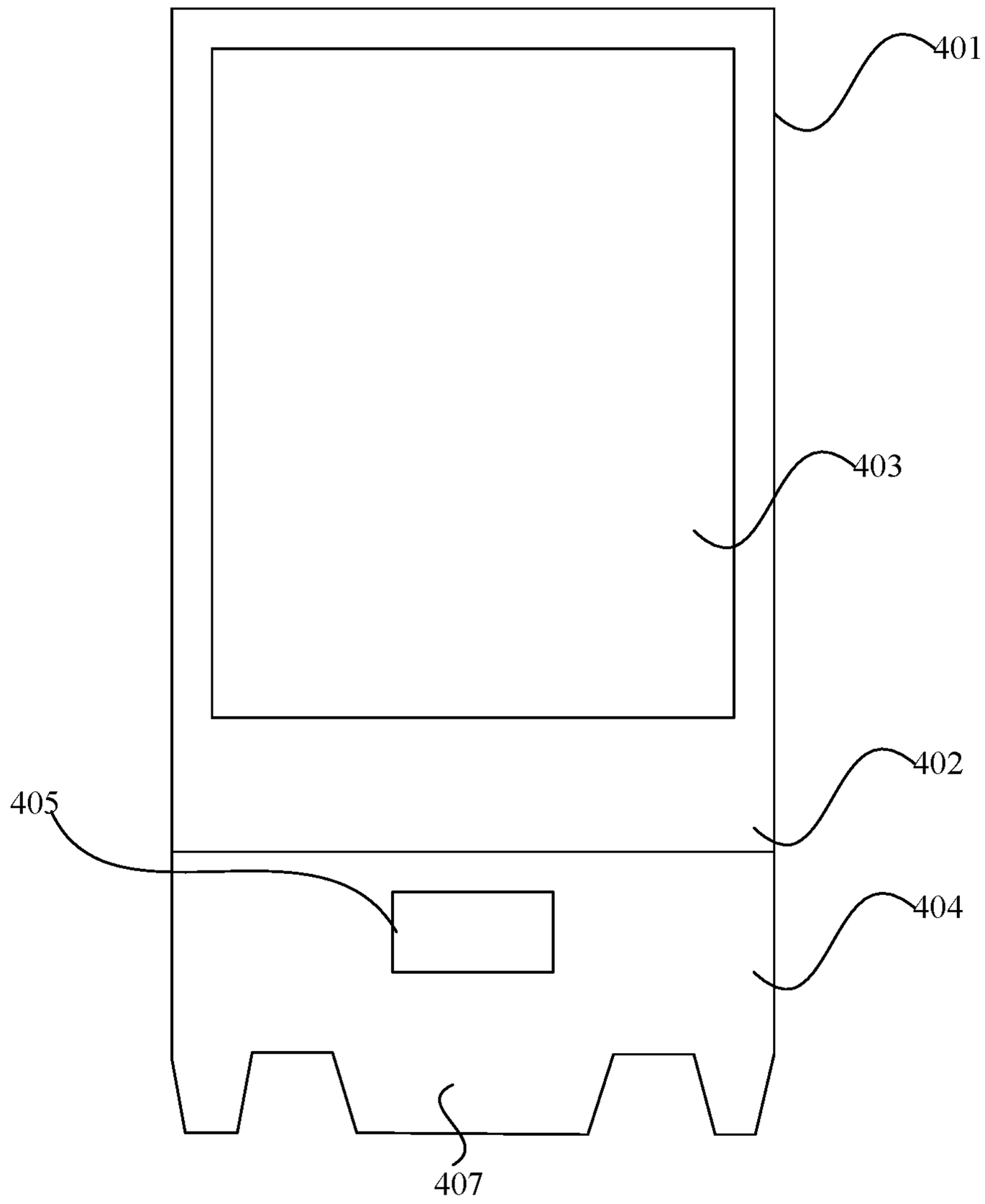

FIG. 12

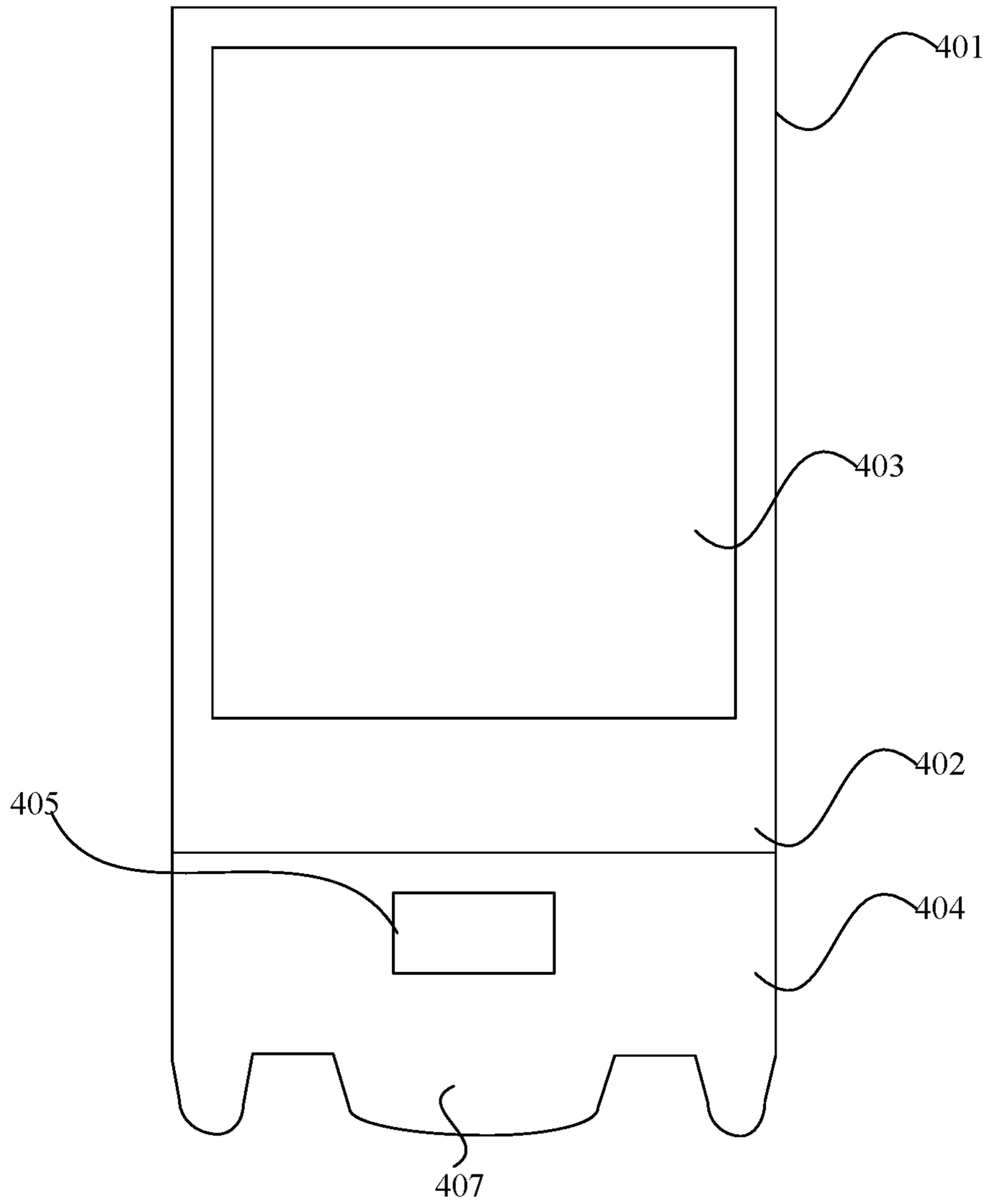

FIG. 13

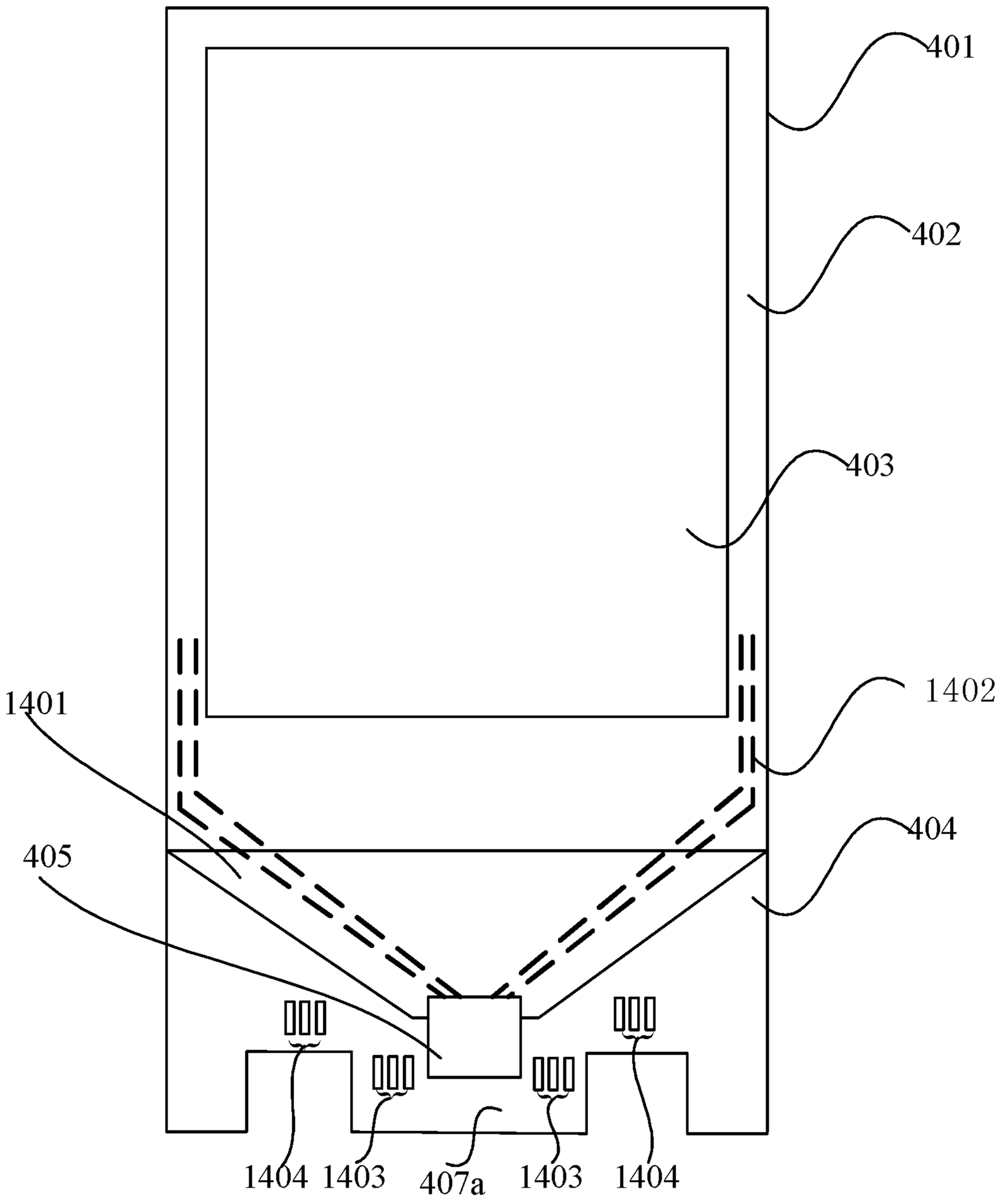

FIG. 14

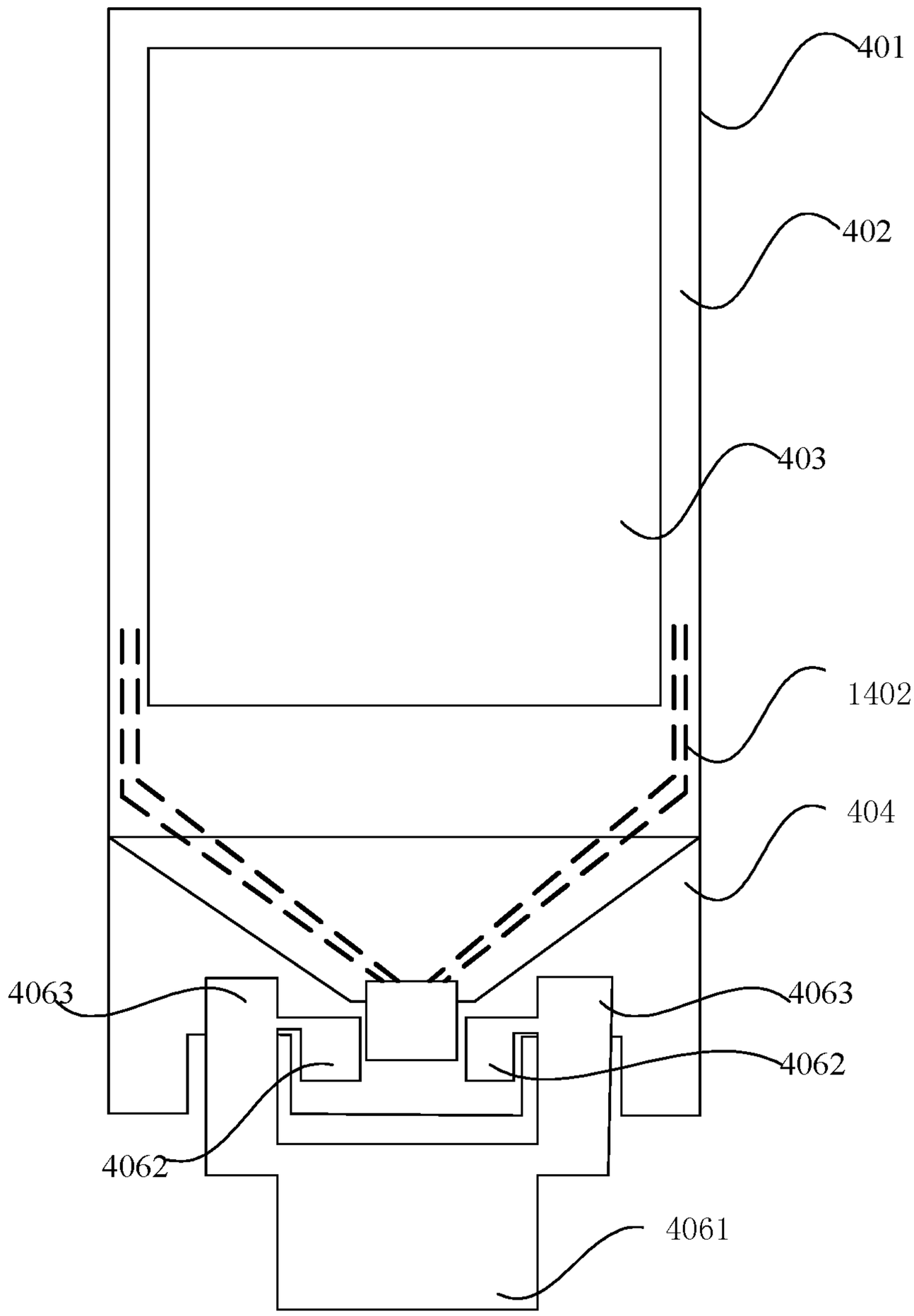

FIG. 15

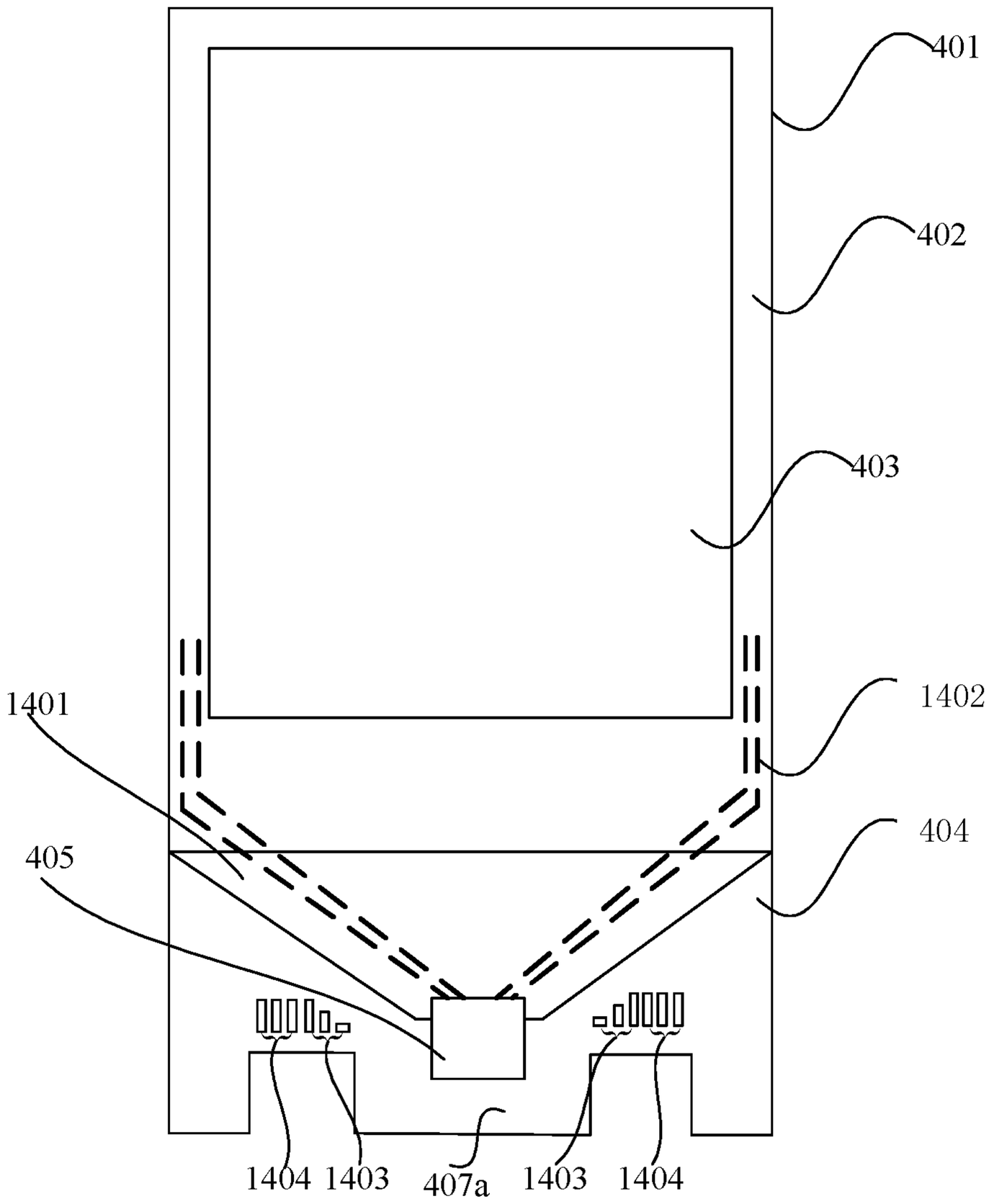

FIG. 16

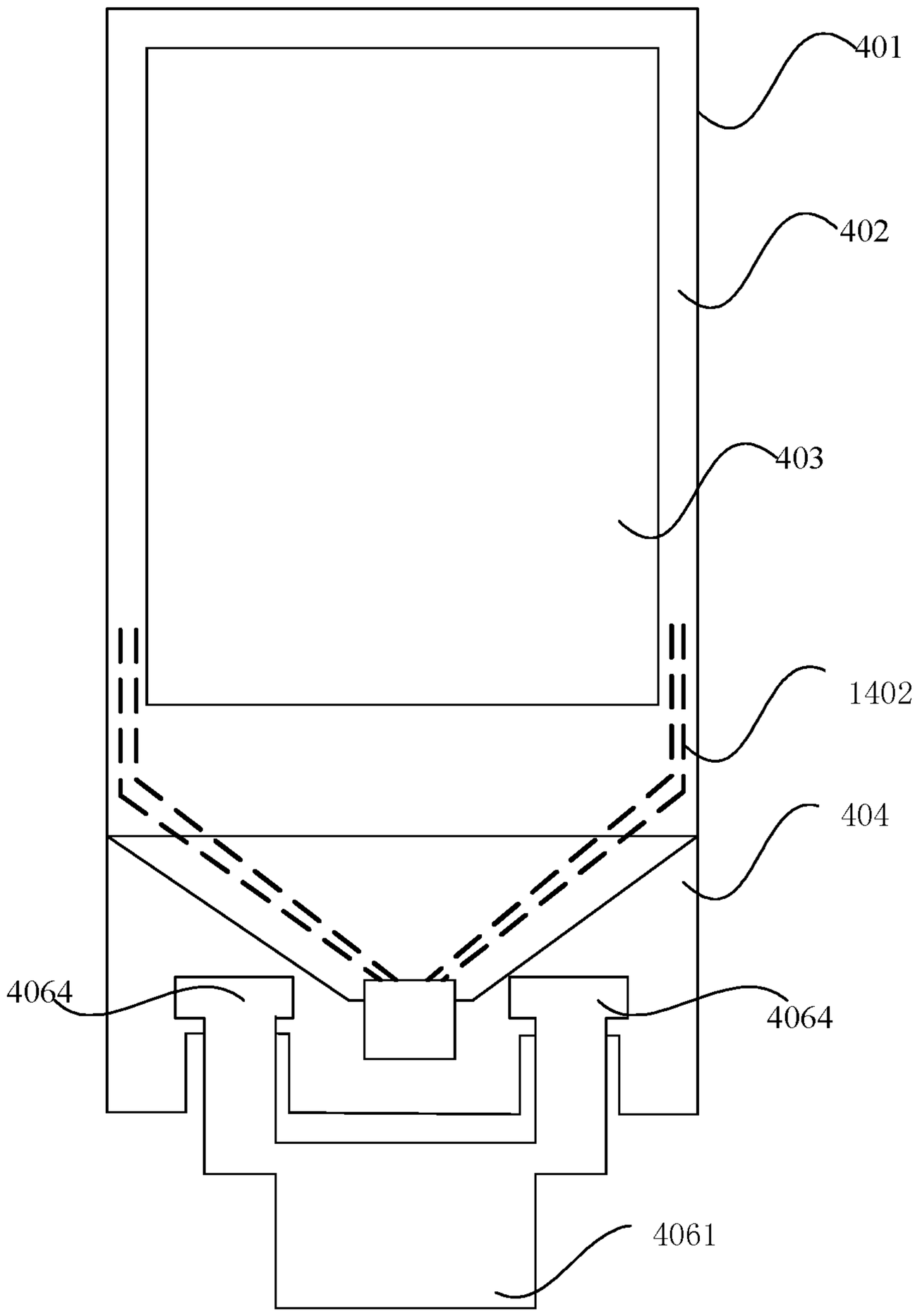

FIG. 17

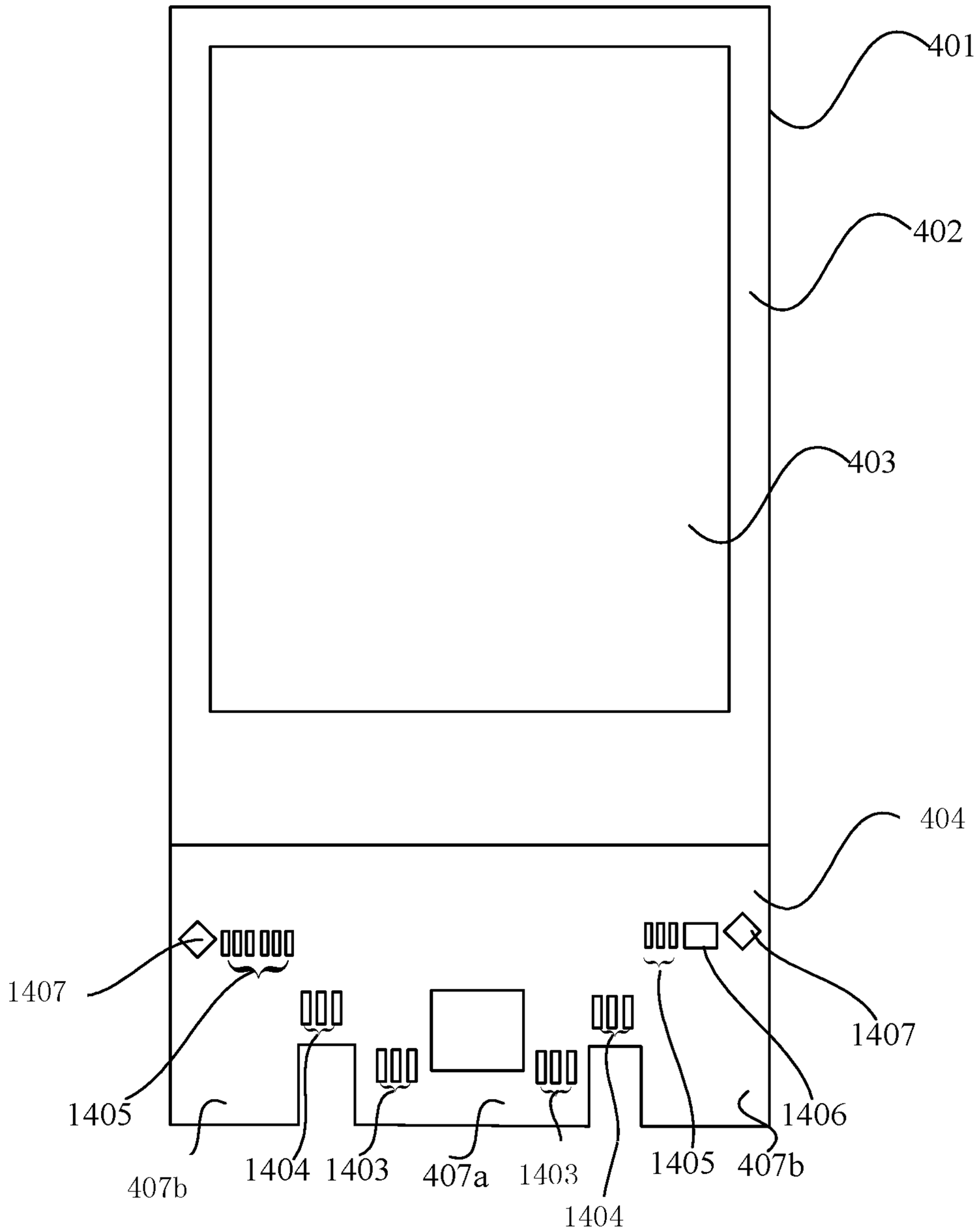
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FIG. 18

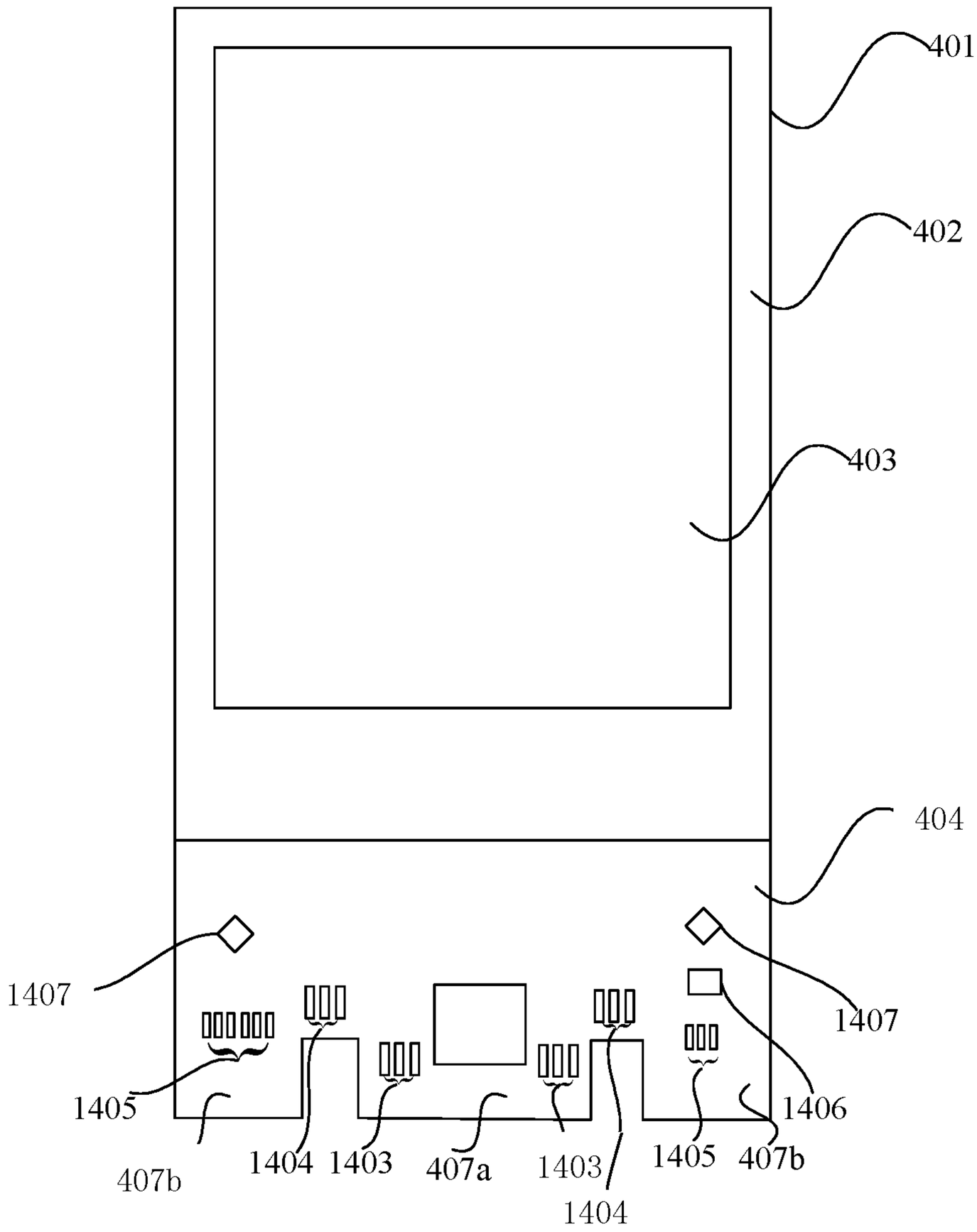
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FIG. 19

BACKLIGHT MODULE AND DISPLAY DEVICE

FIELD OF INVENTION

The present disclosure relates to a field of display technology, and particularly to a backlight module and a display device.

BACKGROUND OF INVENTION

With development of full-screen technology, a screen-to-body ratio of display screens is continuously increasing, area of non-display region of displays (such as a bottom bezel) is getting smaller and smaller, and a distance between the bottom bezel and an edge of the display region is continuously decreasing. Correspondingly, area of light source configuration area (such as a bottom bezel) of backlight modules is also getting smaller and smaller, and a distance between a light guide plate and a backlight module is continuously decreasing.

Because it is necessary to dispose circuit elements such as lateral light sources, light source driving chips, traces, terminals, etc. in the light source configuration area. In order to ensure normal functions of these circuit elements, it is necessary to reserve sufficient area such as a distance between a light guide plate and a bezel of the backlight module should not be less than a predetermined value. Therefore, configuration of current backlight modules cannot meet the development trend of full-screen technology.

That is, current backlight modules have the technical problem that current backlight modules cannot meet the development trend of full-screen technology, and needs improvement.

SUMMARY OF INVENTION

The present disclosure provides a backlight module and a display device to solve the technical problem that current backlight modules cannot meet the development trend of full-screen technology.

In order to solve the problems mentioned above, the present disclosure provides the technical solutions as follows:

Embodiments of the present disclosure provide a backlight module, which include:

a back frame including a light source lateral side for disposing a lateral light source, and a confining lateral side; the light source lateral side and the confining lateral side surrounding to form an accommodating chamber; a light guide plate disposed in the accommodating chamber, and a light incident surface of the light guide plate corresponding to the light source lateral side; the lateral light source disposed between the light source lateral side and the light guide plate; and at least two backlight concave sections formed on the light source lateral side.

In the backlight module provided by an embodiment of the present disclosure, a width of the backlight concave sections is 1% to 50% of a width of the back frame.

In the backlight module provided by an embodiment of the present disclosure, a plurality of protruding sections are disposed on an edge of the light guide plate close to the backlight concave sections, and a location where the protruding sections disposed corresponds to the backlight concave sections.

In the backlight module provided by an embodiment of the present disclosure, the protruding sections include an edge, and a first oblique surface and a second oblique surface which are connected to two ends of the edge; a first included angle formed between the first oblique surface and the light incident surface of the light guide plate is a non-sharp angle; a second included angle formed between the second oblique surface and the light incident surface of the light guide plate is a non-sharp angle.

In the backlight module provided by an embodiment of the present disclosure, the edge of the protruding sections is a straight-line shape or a circular shape.

In the backlight module provided by an embodiment of the present disclosure, a plurality of grid dots are disposed on the light guide plate, a density of the grid dots in a region where the protruding sections correspond to is greater than other region.

In the backlight module provided by an embodiment of the present disclosure, the back frame includes a plastic frame, or a plastic-iron integrated frame.

In the backlight module provided by an embodiment of the present disclosure, at least two of the backlight concave sections separate the light source lateral side into at least three bulge sections, and the lateral light source includes a light source module located in, on, or in and on the bulge sections.

In the backlight module provided by an embodiment of the present disclosure, a third included angle formed between a light-existing direction of a light source which is close to a region of the backlight concave sections in the light source module and the light incident surface of the light guide plate is a sharp angle.

In the backlight module provided by an embodiment of the present disclosure, the third included angle ranges from 0 degree to 45 degrees.

Meanwhile, embodiments of the present disclosure provide a display device, which includes the backlight module provided by the present disclosure, and a display panel; the display panel includes an array substrate, a driving chip and a flexible electric circuit board; the array substrate includes a display region and a non-display region; the driving chip and the flexible electric circuit board are bonded on a side of the non-display region; at least two bumps are formed on a side of the non-display region away from the display region, and a panel concave section is formed between the adjacent bumps; the panel concave sections correspond to the backlight concave sections of the backlight module; part of sections of the flexible electric circuit board are bent to back of the backlight module through an edge of the panel concave section and the backlight concave sections.

In the display device provided by an embodiment of the present disclosure, a bending apex of the flexible electric circuit board is located in the panel concave section and the backlight concave sections.

In the display device provided by an embodiment of the present disclosure, the bumps include at least one first bump, and at least one second bump, and the driving chip is located between an edge of the first bump and an edge of the display region.

In the display device provided by an embodiment of the present disclosure, the driving chip is located out of the first bump; or the driving chip is completely or partially disposed in the first bump.

In the display device provided by an embodiment of the present disclosure, a shape of the bumps includes one or several of a rectangular shape, a trapezoidal shape, a circular arc shape, or a triangular shape.

In the display device provided by an embodiment of the present disclosure, a gate on array (GOA) trace is disposed

inside the array substrate, and the GOA trace includes an oblique section located in the non-display region and directed to the driving chip, the oblique section of the GOA trace is connected to the driving chip; a plurality of signal terminal groups is disposed inside the non-display region for connecting to the flexible electric circuit board.

In the display device provided by an embodiment of present disclosure, the signal terminal group includes a major signal terminal set and a sub signal terminal set, and the major signal terminal set is located between the sub signal terminal set and the driving chip.

In the display device provided by an embodiment of the present disclosure, the sub signal terminal set and the major signal terminal set are spaced apart, and the major signal terminal set is completely or partially located in the first bump, the sub signal terminal set is located out of the first bump.

In the display device provided by an embodiment of the present disclosure, the flexible electric circuit board includes a major section and a connection section, the connection section includes a first block correspondingly connected to the major signal terminal set, and a second block correspondingly connected to the sub signal terminal set; the first block and the second block are disposed in stagger.

In the display device provided by an embodiment of the present disclosure, the signal terminal group further includes a virtual terminal group, the virtual terminal group is located on a side of the sub signal terminal set away from the driving chip and the oblique section of the GOA trace.

The beneficial effect of the present disclosure is that the present disclosure provides a backlight module and a display device. By disposing the backlight concave sections on the light source lateral side of the back frame in the backlight module, the backlight concave sections and the panel concave section on the display panel correspond to each other. During assembling, part of sections of the flexible electric circuit board bent to back of the backlight module through the panel concave section of at least a side of the bumps and an edge of the backlight concave sections to reduce a size of the bottom bezel of the display device, which improves the screen-to-body ratio of the display device, enhances the differentiated performance of the product, and improve market competitiveness of the product.

DESCRIPTION OF DRAWINGS

To more clearly illustrate embodiments or the technical solutions of the present disclosure, the accompanying figures of the present disclosure required for illustrating embodiments or the technical solutions of the present disclosure will be described in brief. Obviously, the accompanying figures described below are only part of the embodiments of the present disclosure, from which figures those skilled in the art can derive further figures without making any inventive efforts.

FIG. **1** is a structural schematic diagram of a current backlight module.

FIG. **2** is a dimension schematic diagram of a current backlight module.

FIG. **3** is a structural schematic diagram of a backlight module provided by an embodiment of the present disclosure.

FIG. **4** is a first schematic diagram of a light guide plate provided by an embodiment of the present disclosure.

FIG. **5** is a second schematic diagram of a light guide plate provided by an embodiment of the present disclosure.

FIG. **6** is a third schematic diagram of a light guide plate provided by an embodiment of the present disclosure.

FIG. **7** is a schematic diagram of a light source module provided by an embodiment of the present disclosure.

FIG. **8** is a schematic diagram of a display device provided by an embodiment of the present disclosure.

FIG. **9** is a schematic diagram of a C-C' cross section of a display device provided by an embodiment of the present disclosure.

FIG. **10** is a dimension schematic diagram of a display device provided by an embodiment of the present disclosure.

FIG. **11** is a schematic diagram of a first type bump of a display device provided by an embodiment of the present disclosure.

FIG. **12** is a schematic diagram of a second type bump of a display device provided by an embodiment of the present disclosure.

FIG. **13** is a schematic diagram of a third type bump of a display device provided by an embodiment of the present disclosure.

FIG. **14** is a schematic diagram of a configuration of a first type terminal of a display device provided by an embodiment of the present disclosure.

FIG. **15** is a schematic diagram of a first type flexible electric circuit board of a display device provided by an embodiment of the present disclosure.

FIG. **16** is a schematic diagram of a configuration of a second type terminal of a display device provided by an embodiment of the present disclosure.

FIG. **17** is a schematic diagram of a second type flexible electric circuit board of a display device provided by an embodiment of the present disclosure.

FIG. **18** is a schematic diagram of a configuration of a third type terminal of a display device provided by an embodiment of the present disclosure.

FIG. **19** is a schematic diagram of a configuration of a fourth type terminal of a display device provided by an embodiment of the present disclosure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The descriptions of embodiments below refer to accompanying drawings in order to illustrate certain embodiments which the present disclosure can implement. The directional terms of which the present disclosure mentions, for example, "top," "bottom," "upper," "lower," "front," "rear," "left," "right," "inside," "outside," "side," etc., are just refer to directions of the accompanying figures. Therefore, the used directional terms are for illustrating and understanding the present disclosure, but not for limiting the present disclosure. In the figures, units with similar structures are used same labels to indicate.

As illustrated in FIG. **1** and FIG. **2**, a current backlight module **10** includes a back frame **101**, a light guide plate **102**, a lateral light source **103** (including a circuit board **1031** and a light emitting diode (LED) light **1032**). A display device includes the backlight module **10** and a display panel **20**. The display panel **20** includes an array substrate **201**, a color film substrate **202** disposed opposite the array substrate **201**, a driving chip **203** disposed on the array substrate **201**, and a flexible electric circuit board **204** bonded to the array substrate **201**. The array substrate **201** includes a display region **211**, and a non-display region **212** adjacent to the display region **211**. A height d of the bottom bezel of the display device is a distance from the bottom edge of the display region **211** to the bottom edge of the display device

is a sum of a distance a between the display region **211** and a visible region of the backlight module **10** (generally aligned with an edge of the color film substrate **202**), a distance b between the visible region of the backlight module **10** and a bottom edge of the backlight module **10**, and a distance c between the bottom edge of the backlight module **10** and the bottom edge of the display device (generally same as the edge of the flexible electric circuit board **204**), which is d=a+b+c.

In prior art, the bottom edge of the display device becomes narrow mainly by increasing an arrangement density of the lateral light source **103** to reduce the light mixing distance, that is, by reducing the value of the distance b between the visible region of the backlight module **10** and the edge of the backlight module **10** to increase the screen-to-body ratio. However, as the bottom bezel gets narrower and narrower, the arrangement space of the lateral light source **103** becomes limited and the arrangement density of the lateral light source **103** cannot be increased. As a result, the size of the bottom bezel d of the display device cannot become smaller by increasing the arrangement density of the lateral light source **103**, thereby the screen-to-body ratio cannot be increased.

The present disclosure addresses the technical problem of the backlight modules and the display devices of prior art, that is, with the bottom bezel getting narrower and narrower, the arrangement space of the light source becomes limited and the arrangement density of light source cannot be increased, which results in not being able to make the size of the bottom bezel of the display device narrower by increasing the arrangement density of the light source. The embodiments of the present disclosure can solve the technical problem.

In an embodiment, as illustrated in FIG. **3**, the backlight module **30** provided by the present disclosure includes:

a back frame **301**, including a plurality of confining lateral sides **3011** and at least one of which is for confining, and at least one light source lateral side **3012** for disposing a lateral light source, and the light source lateral side **3012** and the confining lateral side **3011** surrounds to form an accommodating chamber; a light guide plate **302** disposed in the accommodating chamber, and a light incident surface of the light guide plate **302** corresponding to the light source lateral side **3012**; a lateral light source **303** including a circuit **3031** and a light source **3032** such as a light emitting diode (LED) light, and the lateral light source **303** disposed between the light source lateral side **3012** of the back frame **301** and the light guide plate **302**, that is, located in the accommodating chamber; the light source lateral side **3012** of the back frame **301** corresponds to a light incident surface of the light guide plate **302**, and a light emitting direction of the light source **3032** is toward the light incident surface of the light guide plate **302**.

Further, at least two backlight concave sections **304** are formed on the light source lateral side **3012** of the back frame **301**.

In an embodiment, the back frame **301** includes a plastic frame, a plastic-iron integrated frame, and other embodiments.

In an embodiment, when the back frame **301** is a plastic-iron integrated frame, the plastic-iron integrated frame includes a bottom plate and a surrounding lateral side, and the bottom plate and the lateral side form an accommodating chamber. At this time, it is necessary to form at least two backlight concave sections **304** on the light source lateral side **3012**. It is necessary to simultaneously perform a process at the location on the bottom plate corresponding to the backlight concave sections **304** to form a groove, so that the present disclosure can be realized. In this embodiment, the backlight module is independent of other functional units of the display device, and a reflective sheet is first placed on the bottom plate in the accommodating chamber, and then the light guide plate is placed on the reflective sheet and located in the accommodating chamber.

In an embodiment, when the back frame **301** is a plastic frame, the plastic frame includes a surrounding lateral side to form an accommodating chamber, and the plastic frame does not include a bottom plate. At this time, it is only necessary to form at least two backlight concave sections **304** on the light source lateral side **3012** to realize the present disclosure. In this embodiment, the plastic frame of the backlight module is fixed on other functional units of the display device, and the reflective sheet is first placed on the bottom plate in the accommodating chamber, and then the light guide plate is placed on the reflective sheet and located in the accommodating chamber.

In an embodiment, as illustrated in FIG. **3**, a shape of the backlight concave sections **304** is a rectangular shape or a U-shape, which can be determined according to process conditions or display device configuration requirements.

In an embodiment, a width of the backlight concave sections **304** is 1% to 50% of a width of the bottom plate. In one aspect, the width of the backlight concave sections **304** is required to allow the flexible electric circuit board to pass through the backlight concave sections **304** and be bent, and on the other hand, a sufficient space can be left for a light source placement region to place the lateral light source, so that the backlight module can provide light strong enough for the display panel.

In an embodiment, at least two of the backlight concave sections **304** separate the light source lateral side of the back frame into at least three bulge sections **305**; the lateral light source **303** includes a light source module located in and/or on the bulge sections.

In an embodiment, the lateral light source **303** is located in the bulge sections **305**, and at this time, the bulge sections **305** form a light source placement region.

In an embodiment, as illustrated in FIG. **4**, the lateral light source **303** includes a light source module located in the light source placement region; the light source module includes a first light source set **3031**, a second light source set **3032**, and a third light source set **3033**; the first light source set **301**, the second light source set **3032**, and the third light source set **3033** are driven by a same circuit board for uniformly driven light emission.

In an embodiment, the first light source set **3031**, the second light source set **3032**, and the third light source set **3033** can be driven to emit light respectively by three circuit boards for saving electrical energy.

In an embodiment, as illustrated in FIG. **4**, a shape of the light guide plate **302** is a rectangular shape; the first light source set **3031** and the third light source set **3033** are respectively disposed on two sides of the light guide plate **302**, and the second light source set **3032** is disposed in a middle position of the light guide plate **302** and is respectively disposed opposite part of a region of the light incident surface of the light guide plate **302**; the light emitted from the first light source set **301**, the second light source set **3032**, and the third light source set **3033** enters the region.

In an embodiment, as illustrated in FIG. **5**, a plurality of protruding sections **3021** are disposed on an edge of the light guide plate **302** close to the backlight concave sections (that is the light incident surface), and a location where the protruding sections **3021** are disposed corresponds to the

backlight concave sections **304**; the protruding sections **3021** may not have the optical characteristics of the light incident surface, and is only used for fixing the light guide plate in the bottom plate.

In an embodiment, as illustrated in FIG. **5**, the protruding sections **3021** include an edge, and a first oblique surface and a second oblique surface, which are connected to two ends of the edge; a first included angle a formed between the first oblique surface and the light incident surface of the light guide plate is a non-sharp angle; a second included angle b formed between the second oblique surface and the light incident surface of the light guide plate is a non-sharp angle. The first included angle a ranges from 90° to 135°, and the second angle b ranges from 90° to 135°, so that the light emitted from the first light source set **3031**, the second light source set **3032**, and the third light source set **3033** enters the protruding sections **3021**. As a result, the light emitted by the first light source set **3031**, the second light source set **3032**, and the third light source set **3033** and entered the light guide plate **32** is distributed uniformly, achieving great optical quality.

In an embodiment, degrees of the first included angle and the second included angle can be the same or different.

In an embodiment, the edge of the protruding sections **3021** is a straight-line shape or an arc circular shape, and can be configured according to requirements.

The light guide plate is primarily made of an optical grade acrylic plate, etc. A high-tech material having a very high reflectivity and with no light absorption is used. On a bottom surface of the acrylic plate, applying laser engraving technique and such printing technique to print aa plurality of light guiding points by, and the light guiding points are also known as grid dots. When using the acrylic plate, the optical grade acrylic plate is primarily used to absorb light from the light source and keep the light on the surface of the optical grade acrylic plate. When the light hits each of the grid dots, the reflected light will diffuse to various angles, and then emit from the front side of the light guide plate.

Because there are concave structures such as the backlight concave sections on the backlight module, correspondingly, a pitch of the lateral light source such as the LEDs of the backlight concave sections is larger than other positions, so that the incident light entering the region is relatively less. Therefore, in an embodiment, as illustrated in FIG. **6**, the grid dots **3022** are disposed on a bottom surface of the light guide plate **302**; a density of the grid dots **3022** in the region **3023** where the protruding sections **3021** correspond to (including a front region and a middle region of the protruding sections **321**) is greater than other region, so that brightness of the region **3023** where the protruding sections **3021** corresponds to can be improved to optimize uniformity.

In an embodiment, a depth of the grid dots **3022** in the region **3023** where the protruding sections **3021** correspond to is greater than other region, so that brightness of the region **3023** where the protruding sections **3021** corresponds to can be improved to optimize uniformity.

In an embodiment, as illustrated in FIG. **7**, the lateral light source **303** includes a plurality of LED lights **3032** which are spaced apart along a longitudinal direction of a circuit board **3031** (such as a flexible printed circuit board). The circuit board **3031** is divided into a vertical section and an inclined section. The vertical section and the light guide plate **302** remove a region of the protruding sections **3021**. The inclined section is opposite to a first inclined surface and a second inclined surface of the protruding sections **3021**. The number of the LED lights in each light source module depends on the corresponding plane width.

In an embodiment, as illustrated in FIG. **7**, a third included angle c is formed between a light-exiting direction of a light source, which is close to a region of the backlight concave sections (located on the oblique section of the back plate) in the light source module and the light incident surface of the light guide plate is a sharp angle.

In an embodiment, the third included angle ranges from 0° to 45° to achieve great optical quality.

In an embodiment, the backlight module further includes an optical film disposed on a side of a light exiting surface of the light guide plate, such as a diffusion sheet, and a reflective sheet disposed on a side of the light guide plate away from the light exiting surface, which will not be described in details herein.

In an embodiment, meanwhile, as illustrated in FIG. **8** and FIG. **9**, the present disclosure provides a display device which includes the backlight module **30** and the display panel **40** provided by the present disclosure.

The display panel **40** includes an array substrate **401**, and a color film substrate **402** disposed opposite the array substrate **401**; a display region **403** defined by a surface of the array substrate **401**, and the display region **403** is restricted by sealant; a liquid crystal layer is disposed in the sealant; the color film substrate **402** and the array substrate **401** is combined by the sealant.

A non-display region **404** is formed between outside the display region **403** and an edge of the array substrate **401**; a signal trace is arranged in the non-display region **404**, and a driving chip **405**, a flexible electric circuit board **406**, and other electronic elements are bonded to the non-display region **404**.

The color film substrate **402** is shorter than the array substrate **401**, and the color film substrate **402** is higher than the surface of the array substrate **401**; a stairs region is formed in a region between a projection of a bottom edge of the color film substrate **402** on the surface of the array substrate **401** and an edge of the array substrate **401**; the stairs region is located in the non-display region **404**, and the driving chip **405**, the flexible electric circuit board **406**, and other electronic elements are located on a side of the non-display region **404**, that is, located in the stairs region. The signal trace extends from the stairs region to the entire non-display region **404** and the display region **403**.

When a mother board of the display panel is cut, at least two bumps **407** are reserved at one end of the array substrate **401** away from the display region **403**; panel concave sections **408** are formed between the adjacent bumps **407**; and the panel concave sections **408** and the backlight concave sections **304** of the backlight module are correspondingly disposed.

The flexible electric circuit board **406** includes a connection section connected to the non-display region **404**, a major section bent to the back of the display panel, and a bending section connected to the connection section and the major section; part of the sections (bending section) of the flexible electric circuit board are bent to the back of the backlight module **30** through an edge of the panel concave section **408** and the backlight concave sections **304**.

In an embodiment, the bumps **407** include at least one first bump **407***a*, and at least one second bump **407***b*; the first bump **407***a* is located in a middle position of an end of the array substrate **401**; the driving chip **405** is disposed on a bottom edge of the first bump **407***a*, that is, between an edge of the non-display region **404** and an edge of the display region **403**, thereby raising a height of the upper side of the

driving chip **405** from the edge of the display region **403** and a height of the bottom side of the driving chip **405** from the edge of the non-display region **404**.

In an embodiment, part of the sections (bending section) of the flexible electric circuit board are bent to the back of the backlight module **30** through the panel concave section **408** of at least a side of the bumps **407***a* and an edge of the backlight concave sections **304**.

In an embodiment, to further optimize the effect, a bending apex of the flexible electric circuit board is located in the panel concave section **408** and the backlight concave sections **304**. That is, the bending section is located in the concave region, and a bending radius of the bending section is less than or equal to the height of the first bump **407***a*, that is, the bending section is not extended beyond the panel concave section **408**.

In this embodiment, the first bump **407***a* is disposed based on the number of the driving chips, and the position of the first bump **407***a* and the driving chip is not limited to the middle position of the non-display region. For example, the first bump **407***a* may also be disposed near any side of the non-display region.

In this embodiment, the second bump **407***b* is disposed based on the number of the first bump **407***a* for increasing the contact area of the bumps **407** with the housing of the display device, so that the stress on the display panel is uniform. The second bump **407***b* and the first bump **407***a* are not limited to the staggered arrangement configuration.

In embodiments of the present disclosure, the second bump **407***b* may only have a supporting function, and no circuit elements is disposed in its region, and it may also be used as a configuration area of circuit elements; the circuit elements may be the circuit elements required by the display panel, such as a conversion terminal, and it may also be a circuit element such as a fingerprint recognition element and cameras which are not required by display panels.

Therefore, compared with the display panels of prior art, embodiments of the present disclosure widen the space on the upper and bottom sides of the driving chip **405**, and does not increase the overall height of the non-display region **404**, thereby not only solving the problem concerning the space around the driving chip **405**, but also maintaining the narrow non-display region of display panels of prior art.

Corresponding to FIG. **2**, and as illustrated in FIG. **10**, a height d of the bottom non-display region of the display device is the distance from the display region **403** to the bottom edge of the display device, that is, a sum of a distance a between the display region **403** and a visible region of the backlight module **30**, a distance b between the visible region of the backlight module **30** and a bottom edge of the backlight module **30**, and a distance c between the bottom edge **3** of the backlight module **30** and the bottom edge of the display device, which is d=a+b+c. At this time, the bending apex of the flexible electric circuit board **406** is located outside the panel concave section and the backlight concave sections.

In an embodiment, the bending apex of the flexible electric circuit board **406** is located in the panel concave section **408** and the backlight concave sections **304**. Therefore, the value of the distance c between the edge of the backlight module **30** and the edge of the display device can be reduced compared to a value of c in the display devices of prior art (value of c can be 0). At this time, the height d of the bottom non-display region of the display device is the distance from the display region **403** to the bottom edge of the display device, that is, a sum of the distance a between the display region **403** and a visible region of the backlight module **30**, and the distance b between the visible region of the backlight module **30** and a bottom edge of the backlight module **30**, which is d=a+b. Therefore, the size of the bottom non-display region of the display device in the embodiment of the present disclosure is reduced relative to the bottom non-display region of the display devices of prior art, thereby further realizing a narrow non-display region and a high screen-to-body ratio.

The panel concave section **408** and the backlight concave sections **304** of the backlight module are correspondingly disposed. Generally, an orthographic projection of the backlight concave sections **304** on the backlight module **30** covers an orthographic projection of the panel concave section **408** on the backlight module **30** to protect the display panel **40**. A shape of the backlight concave sections **304** is the same as a shape of the panel concave section **408**, and can be different from each other.

In an embodiment, a shape of the backlight concave sections **304** and the panel concave section **408** is a trapezoidal shape, which can make a density of the lateral light source placed in the light source placement region greater to enhance display effect of the display device.

In an embodiment, for reserving sufficient space to arrange the gate on array (GOA) trace, a fan-out trace, and terminals, a distance between a side of the driving chip close to the display region and an edge of the display region is configured to be larger than a distance between a side of the driving chip close to the first bump and an edge of the first bump.

For example, the driving chip is located in the non-display region and out of the first bump.

For another example, the driving chip is completely or partially disposed in the first bump.

In an embodiment, a shape of the bumps **407** can be a varied shape.

In an embodiment, as illustrated in FIG. **11**, the display panel provided by the present disclosure includes an array substrate **401**, a color film substrate **402**, a display region **403**, and bumps **407** formed on an end of the array substrate **401**. A driving chip **405** is disposed in the non-display region **404** of the array substrate **401**.

The bumps **407** include two short edges disposed symmetrically, which are connected to an edge of the non-display region **404**, and a long edge connected to the two short edges; for example, as illustrated in FIG. **11**, the short edges are straight edges, and the short edges are perpendicular to the edge of the non-display region **404**. At this time, a surface shape of the bumps **407** is a rectangular shape.

In an embodiment, the bumps **407** include two short edges disposed symmetrically, which are connected to an edge of the non-display region **404**, and a long edge connected to the two short edges; as illustrated in FIG. **12**, the differences between the display panel in this embodiment and FIG. **11** include the short edges are straight edges, and an included angle formed between the short edges and the edge of the non-display region **404** is not a right angle, that is the included angle is greater than or less than 90 degrees, and a surface shape of the bumps **407** is a trapezoidal shape.

In an embodiment, as illustrated in FIG. **13**, the differences between the display panel provided by this embodiment and FIG. **11**, FIG. **12** include the bumps **407** include an outer circular arc edge, two ends of the outer circular arc edge are connected to the edge of the non-display region **404**, and the ends of the outer circular arc has an inner arc transition.

The terminal setting method of the flexible electric circuit board will now be described.

As illustrated in FIG. **14**, the display panel provided by the present disclosure includes an array substrate **401**, a color film substrate **402**, a non-display region **404** located in non-display area of the array substrate **401**, a driving chip disposed in the non-display region **404**, and a fan-out trace **1401** connected to the driving chip **405**, for example, the fan-out trace **1401** is for transmitting a display data signal into the display region **403**; at least a set of a GOA trace **1402** (gate driving circuit) is disposed in the non-display region **404**. Take two sets of the GOA trace **1402** as an example for describing, the two sets of the GOA trace **1402** include a parallel section located outside the display region **403** and parallel to an edge of the display region **403**, and an oblique section located in the non-display region **404** and directed to the driving chip **405**. The oblique section of the GOA trace **1402** is connected to the driving chip **405** to input a gate signal, and the parallel section of the GOA trace **1402** is connected to scan lines of each pixel row to output the gate signal.

A plurality of signal terminal groups is disposed inside the non-display region **404** for connecting to the flexible electric circuit board. The signal terminal group at least includes a major signal terminal set **1403** and a sub signal terminal set **1404**. For example, the major signal terminal set **1403** includes a pixel data signal and a gate signal, and the sub signal terminal set **1404** includes a power source signal, etc.; the major signal terminal set **1403** is located between the sub signal terminal set **1404** and the driving chip **405** to reduce delay of data transmission.

In an embodiment, as illustrated in FIG. **14**, the major signal terminal set **1403** is disposed close to the driving chip **405**; the sub signal terminal set **1404** is disposed away from the driving chip **405** and the oblique section of the GOA trace **1402**. Because the driving chip **405** is relatively moved downward, the oblique section of the GOA trace **1402** connected to the driving chip **405** is simultaneously moved downward, thereby compressing the configuration space of the terminal. If the terminal is too close to the GOA trace **1402**, the impedance will increase, distorting the signal and affecting the display quality. Therefore, embodiments of the present disclosure dispose at least part of the terminals away from the GOA trace **1402**.

In an embodiment, the sub signal terminal set **1404** and the major signal terminal set **1403** are spaced apart, and the major signal terminal is completely or partially located in the first bump **407***a*, the sub signal terminal is located out of the bumps **407**. Thereby, the distance between the terminals and the GOA trace **1402** is effectively controlled to reduce the impedance.

As illustrated in FIG. **15**, the flexible electric circuit board includes a major section **4061** and a connection section for connecting the signal terminal groups; the connection section includes a first block **4062** correspondingly connected to the major signal terminal set **1403**, and a second block **4063** correspondingly connected to the sub signal terminal set **1404**; the first block **4062** and the second block **4063** are disposed in stagger.

As illustrated in FIG. **16**, compared with the signal terminal arrangement configuration of FIG. **14**, the terminals are closely arranged, and the major signal terminal set **1403** and the sub signal terminal set **1404** are both disposed outside the first bump **407***a*, thereby preventing compressing the space of the first bump **407***a*; and the area of each terminal in the major signal terminal set **1403** is equivalent to the area of each terminal of the sub signal terminal set **1404** to ensure a stable connection of signal contact points.

In an embodiment, the height of each terminal of the major signal terminal set is less than the height of each terminal of the sub signal terminal set, and the width of each terminal of the major signal terminal set is wider than the width of each terminal of the sub signal terminal set; by reducing the height of the terminals close to the GOA trace **1402** to maintain the distance between the GOA trace **1402**, thereby reducing the impedance generated between the terminals and the GOA trace **1402**.

In an embodiment, the height of each terminal in the major signal terminal set **1403** is decreasing from the terminal of the oblique section away from the driving chip **405** and the GOA trace **1402** to the terminal of the oblique section close to the driving chip **405** and the GOA trace **1402**; further, the width of each of the terminals in the major signal terminal set **1404** is increasing from the terminal of the oblique section away from the driving chip **405** and the GOA trace **1402** to the terminal of the oblique section close to the driving chip **405** and the GOA trace **1402**, thereby ensuring the distance between each terminal and the GOA trace **1402** is equal.

As illustrated in FIG. **17**, the flexible electric circuit board includes a major section **4061** and a connection section **4064** for connecting the terminals; the end of the connection section **4064** is a regular polygon; a first connection region and a second connection region are disposed on the connecting section **4064**; the first connection region covers and connects to the major signal terminal set, and the second connection region covers and connects to the sub signal terminal set.

In an embodiment, a virtual terminal group is disposed in the non-display region **405**, and the virtual terminal group is located on a side of the sub signal terminal set away from the driving chip and the oblique section of the GOA trace. The virtual terminal group can support the flexible electric circuit board to ensure the flatness of the display panel.

The circuit configuration on the second bump will now be described.

In an embodiment, as illustrated in FIG. **18**, the display panel provided by the present disclosure includes an array substrate **401**, a color film substrate **402**, a non-display region **404** located in non-display area of the array substrate **401**, and a testing terminal group **1405**, a conversion terminal group **1406**, and a recognition terminal group **1407** disposed in the non-display region **404**. At least one of the testing terminal group **1405**, the conversion terminal group **1406**, and the recognition terminal group **1407** is located between an edge of the second bump **407***b* and an edge of the display region **403**.

Terminals of the testing terminal group **1405**, the conversion terminal group **1406**, and the recognition terminal group **1407** can be disposed in a same row between an edge of the second bump **407***b* and an edge of the display region **403**, and can be disposed in a plurality of rows between an edge of the second bump **407***b* and an edge of the display region **403**.

In an embodiment, for increasing a gap between the testing terminal group **1405**, the conversion terminal group **1406**, and the recognition terminal group **1407**, as illustrated in FIG. **19**, in the display panel provided by the present disclosure, the testing terminal group **1405**, the conversion terminal group **1406**, and the recognition terminal group **1407** are disposed in at least two rows.

The terminals in the test terminal group **1405** are used for the performance test of the display panel by inputting a test

signal to the terminals in the test terminal group **1405** after the array substrate is prepared into a display panel. The terminals in the conversion terminal group **1406** are used for coating conductive silver paste, and the conductive silver paste is used for connecting a ground line (not shown) in the non-display region **401** of the array substrate and a conductive layer of the color filter substrate disposed opposite the array substrate in the display panel to achieve anti-static effect. The terminals in the recognition terminal group **1407** are used to record information about the array substrate, as well as for alignment and the like.

According to embodiments mentioned above:

The present disclosure provides a backlight module and a display device. By disposing the backlight concave sections on the light source lateral side of the back frame in the backlight module, the backlight concave sections and the panel concave section on the display panel correspond to each other. During assembling, part of sections of the flexible electric circuit board bent to the back of the backlight module through an edge of the panel concave section and the backlight concave sections to reduce a size of the bottom bezel of the display device, which improves the screen-to-body ratio of the display device, enhances the differentiated performance of the product, and improves market competitiveness of the product.

In summary, although the present disclosure has disclosed the preferred embodiments as above, however the above-mentioned preferred embodiments are not to limit to the present disclosure. A person skilled in the art can make any change and modification, therefore, the scope of protection of the present disclosure is subject to the scope defined by the claims.

What is claimed is:

1. A backlight module, comprising:

a back frame comprising a light source lateral side for disposing a lateral light source, and a confining lateral side; and the light source lateral side and the confining lateral side surrounding to form an accommodating chamber;

a light guide plate disposed in the accommodating chamber, and a light incident surface of the light guide plate corresponding to the light source lateral side;

the lateral light source disposed between the light source lateral side and the light guide plate;

wherein at least two backlight concave sections are formed on the light source lateral side,

wherein the backlight module is disposed corresponding to a display panel, and

wherein the display panel comprises an array substrate, a driving chip, and a flexible electric circuit board; the array substrate comprises a display region and a non-display region; the driving chip and the flexible electric circuit board are bonded on a side of the non-display region; at least two bumps are formed on a side of the non-display region away from the display region; a panel concave section is formed between the adjacent bumps; the panel concave sections correspond to the backlight concave sections of the backlight module; and part of sections of the flexible electric circuit board is bent to back of the backlight module through an edge of the panel concave section and the backlight concave sections.

2. The backlight module as claimed in claim **1**, wherein a width of the backlight concave sections is 1% to 50% of a width of the back frame.

3. The backlight module as claimed in claim **1**, wherein a plurality of protruding sections are disposed on an edge of the light guide plate close to the backlight concave sections, and a location where the protruding sections disposed corresponds to the backlight concave sections.

4. The backlight module as claimed in claim **3**, wherein the protruding sections comprise an edge, and a first oblique surface and a second oblique surface which are connected to two ends of the edge; a first included angle formed between the first oblique surface and the light incident surface of the light guide plate is a non-sharp angle; a second included angle formed between the second oblique surface and the light incident surface of the light guide plate is a non-sharp angle.

5. The backlight module as claimed in claim **4**, wherein the edge of the protruding sections is a straight-line shape or a circular shape.

6. The backlight module as claimed in claim **3**, wherein a plurality of grid dots are disposed on the light guide plate, a density of the grid dots in a region where the protruding sections correspond to is greater than other region.

7. The backlight module as claimed in claim **1**, wherein the back frame comprises a plastic frame, or a plastic-iron integrated frame.

8. The backlight module as claimed in claim **1**, wherein at least two of the backlight concave sections separate the light source lateral side into at least three bulge sections, and the lateral light source comprises a light source module located in and/or on the bulge sections.

9. The backlight module as claimed in claim **8**, wherein a third included angle formed between a light-exiting direction of a light source which is close to a region of the backlight concave sections in the light source module and the light incident surface of the light guide plate is a sharp angle.

10. The backlight module as claimed in claim **9**, wherein the third included angle ranges from 0 degree to 45 degrees.

11. A display device, comprising a backlight module and a display panel; wherein the backlight module comprises:

a back frame comprising a light source lateral side for disposing a lateral light source, and a confining lateral side; and the light source lateral side and the confining lateral side surrounding to form an accommodating chamber;

a light guide plate disposed in the accommodating chamber, and a light incident surface of the light guide plate corresponding to the light source lateral side; and

the lateral light source disposed between the light source lateral side and the light guide plate, wherein at least two backlight concave sections are formed on the light source lateral side; and

wherein the display panel comprises an array substrate, a driving chip, and a flexible electric circuit board; the array substrate comprises a display region and a non-display region; the driving chip and the flexible electric circuit board are bonded on a side of the non-display region; at least two bumps are formed on a side of the non-display region away from the display region; a panel concave section is formed between the adjacent bumps; the panel concave sections correspond to the backlight concave sections of the backlight module; and part of sections of the flexible electric circuit board is bent to back of the backlight module through an edge of the panel concave section and the backlight concave sections.

12. The display device as claimed in claim **11**, wherein a bending apex of the flexible electric circuit board is located in the panel concave section and the backlight concave sections.

13. The display device as claimed in claim 11, wherein the bumps comprise at least one first bump, and at least one second bump, and the driving chip is located between an edge of the first bump and an edge of the display region.

14. The display device as claimed in claim 13, wherein the driving chip is located out of the first bump; or the driving chip is completely or partially disposed in the first bump.

15. The display device as claimed in claim 12, wherein a shape of the bumps comprises one or several of a rectangular shape, a trapezoidal shape, a circular arc shape, or a triangular shape.

16. The display device as claimed in claim 12, wherein a gate on array (GOA) trace is disposed inside the array substrate, and the GOA trace comprises an oblique section located in the non-display region and directed to the driving chip, the oblique section of the GOA trace is connected to the driving chip; a plurality of signal terminal groups is disposed inside the non-display region for connecting to the flexible electric circuit board.

17. The display device as claimed in claim 16, wherein the signal terminal group comprises a major signal terminal set and a sub signal terminal set; the major signal terminal set is located between the sub signal terminal set and the driving chip.

18. The display device as claimed in claim 17, wherein the sub signal terminal set and the major signal terminal set are spaced apart, and the major signal terminal set is completely or partially located in the first bump, the sub signal terminal set is located out of the first bump.

19. The display device as claimed in claim 18, wherein the flexible electric circuit board comprises a major section and a connection section, the connection section comprises a first block correspondingly connected to the major signal terminal set, and a second block correspondingly connected to the sub signal terminal set, and the first block and the second block are disposed in stagger.

20. The display device as claimed in claim 17, wherein the signal terminal group further comprises a virtual terminal group, the virtual terminal group is located on a side of the sub signal terminal set away from the driving chip and the oblique section of the GOA trace.

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